NEWTON'S

LONDON JOURNAL

OF

Arts and Sciences;

BEING

A RECORD OF THE PROGRESS OF INVENTION AS APPLIED TO THE ARTS.

[ESTABLISHED IN THE YEAR 1820.]

NEW SERIES.

VOL. XXI.

London:

PUBLISHED BY NEWTON AND SON, AT THE OFFICE FOR PATENTS, 66 CHANCERY LANE; KENT AND CO., PATERNOSTER ROW; SIMPKIN, MARSHALL, AND CO., STATIONERS' COURT; C. B. FRANCIS AND CO., BROADWAY, NEW YORK; AND LUDWIG DENICKE, LEIPZIG.

1865.

R. FOLKARD, PRINTER,
DEVONSHIRE STREET, QUEEN SQUARE,
BLOOMSBURY.

LIST OF PLATES IN VOL. XXI.

[NEW SERIES.]

INDEX TO VOL. XXI.

[NEW SERIES.]

NEWTON'S

London Journal of Arts and Sciences.

No. CXXI. (NEW SERIES), January 1st, 1865.

THE MAGNESIUM LIGHT.

The importance of artificial light to the comfort of the whole community is so great, that any new discovery in this direction is pretty certain to attract a large share of public attention. Nor is this surprising when we remember that during a considerable portion of the time of our in-door life we are dependent upon the assistance of artificial light; and that the character and quality of the light which we use are matters for serious consideration, if we are to turn to the best account the many long hours of darkness which, in northern countries, intervene between day-light and the time for rest.

Of late years the improvements which have been brought to this branch of our social mechanism have been both great and numerous; and what with the introduction of gas, the invention of lamps of different kinds, fitted for burning oil and the liquid hydrocarbons, and the improvements introduced into the manufacture of candles, we have advanced far in the art of creating compensation for the absence of the light of day; so far indeed, that, with respect to domestic lighting, we might almost be disposed to think there is little room for improvement, did we not every day witness the most unlooked for development of new, or applications of old and well-known, principles. The history of artificial lighting, during the last forty or fifty years, affords as strong an illustration of this truth as perhaps any subject connected with industrial affairs. Not more than forty years ago the oil lamp and some form of the tallow candle were the only means of artificial lighting; first came improvements in the oil lamps, then the invention of others upon a new principle, such as the carcel and moderator lamps; following upon these, was the introduction of camphine, with a lamp proper for burning it; and, lastly, the use of petroleum, obtained from various sources, with a variety of lamps adapted to its consumption. Besides this, during the whole of the time the gas manufacture has been gradu-

ally extending itself, until, for the public streets and shops, gas has come to be the universal source of light.

On some few occasions, in the course of scientific progress, means for obtaining light have been pointed out of a very different character from those that we have mentioned; and so, at different times, we have had the electric light, with its various modifications, the oxyhydrogen or lime light, and now we have the "magnesium light."

It was long ago observed by scientific experimentalists, that certain substances of an earthy character were incapable of fusion, even when heated to a very high degree, but that when so heated they became incandescent and luminous, and that their luminosity exceeded that produced by any ordinary combustion.

As far back as the beginning of this century it was particularly observed that lime possessed this property of becoming luminous when heated; and it was discovered, that when a burning jet of the mixed gases, oxygen and hydrogen, was thrown upon a fragment of lime, the latter became intensely ignited, and threw off a light of unequalled splendor. This constituted the oxyhydrogen or lime light, which at one time formed a favorite subject for the popular lecture table, and the effects of which have been witnessed by the public over and over again. From its great penetrative power, this light has been found of great use on some occasions as a signal; but, for reasons which will be presently stated, it has never been made available for ordinary illumination.

Like lime, the earth magnesia was also shown to possess the power of giving off a brilliant light, when heated in the flame of the oxyhydrogen blowpipe; and the light from magnesia was found to excel in intensity that from lime. There are other solids of infusible character, which become vividly luminous when heated up to a very high point; the metal platinum is one of these; and there is something very remarkable and characteristic in the light produced by this ignition without combustion.

In 1807, Sir Humphrey Davy made the unexpected discovery that the real bases of the alkalies and the earths were metals; and he succeeded in isolating and obtaining, in the metallic state, the metals sodium and potassium. The distinguishing character of these substances is the avidity which they are seized upon by oxygen—their tendency to unite with that element being so strong, that oxidation commences the moment they are exposed to its influence; and the action between the two is often so rapid, that the metal ignites without the application of flame or heat. Since Sir Humphrey Davy's time, others of the metallic bases have been separated; and so late as 1828, aluminium—the metal radical of clay—and, in 1829, magnesium—the

metal of magnesia—were first obtained. It is with the latter, as the source of the magnesium light, that we are at present concerned.

Magnesium is a light, silvery-white metal, of the low specific gravity 1·75—less than double the weight of water. It is fusible at a red heat, and somewhat ductile, as it can be drawn into wire which possesses considerable tenacity, and which can be rendered slightly elastic by condensation between rollers, as in the process of flattening. It is a highly oxidizable metal; and when bright surfaces of it are exposed to the air, they soon become coated over with a white substance, which is the common magnesia. The extraction of these metals of the alkalies and earths from the compounds in which they exist in nature has been a difficult problem for chemists; and it remains now only half solved. In 1854, Mr. Deville, a French chemist, made known processes by which he had succeeded in separating the metal aluminium, in such quantities and at such a price that it has since then gradually taken its place as an article of commerce; and now, by the persevering labours of M. Sonstadt, magnesium will, no doubt, be brought into the same category with aluminium. But still the problem of extracting these metals can scarcely be said to be satisfactorily disposed of, when we find substances naturally so abundant in their compounds that they can be obtained at the very cheapest rate, worth many shillings per ounce. Common clay and the magnesian rocks offer an unlimited supply of aluminium and magnesium; and until ready means are found for setting free the metallic treasure locked up in their masses, it must be considered that the work of the chemist has fallen short of a successful issue.

In consequence of its avidity for oxygen, magnesium is really a combustible substance. All ordinary combustion is simply oxidation, and the resultants of the combustion are oxides of the things burned; but to produce light something is necessary to the character of the combustible besides the property of burning. When lime or magnesia are heated in the oxyhydrogen flame, there is no combustion of the earthy matter, but the intense light is simply the consequence of the ignition of substances which are unchangeable both mechanically and chemically. In this respect there is a great difference between the manner in which these lights are produced and that in which light from burning oil or gas is produced; as, in the latter, the principle to be burned and the ignitible solid matter are united, and the ignition of the solid is merely consecutive to the burning of the combustible vehicle, so to speak; after all, the solid ignitable matter is finally oxidized, having done its duty as a light-producer, and so passes away, to be followed by successive atoms of similar character—the whole mass of the combustible substance being consumed in proportion. A combustible which does not contain

solid matter susceptible of ignition is wholly incapable of giving light. The production of the powerful light which is given off during the burning of magnesium is to be traced to this principle.

It has been already stated, that the earth magnesia, when ignited in the oxyhydrogen flame, yields a light surpassing the lime light in power; the production of the intense light obtained during the combustion of magnesium depends upon the property of the metal to oxidize into the earth magnesia. The metal itself being very oxidizable, or, in other words, combustible, furnishes, in burning, flame and heat. The result of this burning is the atomic formation, in the mass of the flame, of particles of ignitible magnesia; and these being intensely heated, in what may be termed their nascent state, give off the brilliant pure light characteristic of the phenomenon.

The quality of the light produced by this means, as well as by igniting lime, is a matter for some consideration. Whatever their value may be for special applications, these lights have never been successfully employed for ordinary illumination. About twenty-two or twenty-three years ago the large room of the Adelaide Gallery of Practical Science was lighted by several lime lights, but the experiment proved completely unsuccessful; and indeed the character of these lights renders them quite unfit for ordinary lighting. It is difficult to determine the true reason for this; particularly when it is remembered that the light is not only brilliant, but that its spectrum approximates to that of the sun; practically, however, there is an extraordinary difference between these lights, including the electric light and those produced by combustion of materials in which carbon constitutes the ignitable solid. In lights of the latter constitution, there exists a power of diffusibility, by which the light seems to have the property of charging the atmosphere with light in every direction, so that remote corners of the room for instance receive a certain amount of illumination, and objects not directly opposed to the course of the rays are more or less distinctly visible. The electric, lime, and magnesium lights possess none of this diffusiveness; their rays seem to be projected with a force and velocity which deprives them of the power of diffusion. An object placed in the direct course of the rays is splendidly illuminated, and the rays are projected to an immense distance; but the shadows cast by intervening objects are intensely black, and the rays seem to pass through the atmosphere without producing much effect, except upon that part which is in the course of the stream of light; but for signals either by land or by sea, these lights possess the best qualities, as the very want of diffusiveness, which renders them unfitted for common use, is of the greatest advantage in a light which is intended to display itself in certain directions only.

The great impediment to the use of the electric and lime lights was the cumbrousness of the apparatus and the difficulty of the manipulation connected with them; and this, in the case of signals required suddenly, was of course perfectly prohibitory to their use. As the magnesium light is obtained by simple combustion of a thin and narrow riband of the metal, however, this impediment is completely removed; and in cases where a flash of the most intense light is suddenly required, it may be obtained by means of magnesium with as little trouble as lighting a common oil lamp.

The quality of the light *per se*, that is as to its composition, approaches very nearly to that of the sun. The most delicate tints of blue, green, light reds, and primrose are as distinguishable in the magnesium light as in daylight; and what is more remarkable, the actinic or photogenic power of the light appears to be almost as great as the light of day. Photographs taken in a few seconds resemble those taken by day.

Altogether, the discovery of the magnesium light is a matter of great interest, not, however, because it is likely to be applied to ordinary illumination, for it is in nowise suitable to such a use; but because, on account of the facility with which the light can be produced, without the employment of costly apparatus, and without the least previous preparation, it may be employed as a signal light with incomparable advantage. Placed in the focus of a parabolic reflector, a cylinder of light might be projected without a moment's loss of time to an immense distance, and many a terrible catastrophe at sea may be averted by the command of so simple and effective an auxiliary. As a photographic agent, it is possible that it might likewise prove valuable, but as a means of ordinary illumination, it is, we believe, quite useless. It is as a signal light that its value, if it possess any, must be manifested; and certainly to have the power of producing a light of unequalled intensity, and penetrating power, in an apparatus no bigger than a man's hat,* and without the least previous preparation, ought to be a valuable thing for the purposes of shipping, and for military and other uses on land.

T. W. K.

* This apparatus consists in a common reflector, in the centre of which the riband of magnesium is held by a small clip, through which it is slowly projected by a piece of mechanism, in proportion as it is burned away.

GOVERNMENT SCHOOLS OF ART.

TWENTY-SEVEN years have now elapsed—says the recently-issued report of the select committee appointed to inquire into the constitution and working, and into the success, of the Government Schools of Art—since the first establishment (in 1837) of a Government School of Design. The House of Commons, bearing in mind that during these many years grants had been regularly voted, ostensibly for the education of designers, with the view to the improvement of our art manufactures, no doubt considered it high time that the results of this expenditure should be made manifest; and hence the appointment of the select committee.

This is not the first committee which has directed its enquiries to a similar object, or which has felt constrained to issue an unfavourable report of the established system. An inquiry set on foot in the year 1849, resulted in the condemnation of the schools of design, and these gave place, in 1852, to a new system of teaching. Head quarters were established at South Kensington, from whence certificated masters were sent out to all parts of the United Kingdom, when their services were demanded. The masters were to be remunerated partly through government grants, which were apportioned according to their respective qualifications, and partly through the payment of pupils and local subscriptions.

The prospect thus opened up was a glorious one for many a poor lad having a leaning towards the fine arts; for here was an opportunity of obtaining not merely an artistic education gratis, but so liberal were the ideas of the founders of the new Institution, that a weekly allowance ranging from five shillings to thirty shillings, according to the progress of the pupil, was offered him while qualifying himself for a teacher; besides which, something very like a promise of a comfortable provision for life was held out to him. Young men were not slow to avail themselves of the advantages thus presented, and in due time a goodly number became certificated teachers. These were drafted off, as soon as qualified, to various parts of the country where a disposition had been shown to encourage the establishment of schools of art. In process of time, however, all the available posts were filled; and then arose complaints from those who, after toiling for some four, five, and even six years through the drudgery of a fixed routine of studies, found themselves no nearer the goal than when they first earned their scholarships. Concurrent with this arose other difficulties. In order to inaugurate the new system, the heads of the department of Practical Art (as the new institution was termed) visited the manufacturing districts, where they held sensation meetings, using the name of the late Prince Consort

—who was undoubtedly in earnest in furthering the progress of decorative art—as a charm to collect together the magnates of the large towns. By these means, promises of local support were extracted in most unpromising places; and the machinery of South Kensington was set going to hit the iron while it was hot, and establish schools of art in every direction.

At first the success was great; that is, the local contributions, school payments, and Government payments served to cover all expenses, and afford the master a decent maintenance; but after a while the manufacturers contracted their contributions, and the scholars, wearying of their routine studies, which had no very direct bearing, as they could see, on their special artistic wants, declined in numbers. In order, however, that the nation might be thoroughly imbued with art, and possibly that the number of students might figure well in the returns, the masters were put into communication with the national schools, with the view of teaching those children whose parents consented to pay one penny per week for their instruction in art; but this also proved a partial failure, from the governors of the parochial schools refusing to pay the modest tariff of £5 per annum.* The subscription of artizans was fixed at two shillings per month, a sum which many of the masters considered so small as to induce careless in their attendance. But whatever the cause, the result neither satisfied the manufacturers nor the heads of the Department, and a novel mode of administering the government grant was, therefore, instituted, in the years 1862 and 1863.

Instead of supplementing, as heretofore, the income of the masters, according to their certificates of artistic merit, the quality and quantity of their pupils' productions were to be assessed, and their salary proportioned accordingly. This would, it was thought, stimulate the masters to exert themselves; and that it certainly has done, but in a manner somewhat different from what was contemplated. On this subject the master of the Dundee school writes:—"The payment on results placed the master at the mercy of the students: *e.g.*, the best of my science class, for whom I expected £3 or £4, refuses from some pique or caprice to attend the examination; I cannot, therefore, get the money which I have earned by teaching him." In his simplicity, he had considered his duty done when he had earned his money. Another master, wiser in his generation, finding himself likely to be left in the lurch, gave a pupil his dinner at his own house for a fortnight, in order that he might be induced to complete his drawing; and to several

* A tabulated statement of answers, being replies of masters to a circular of questions issued by the Committee of Art Masters, affords very curious information on these and other points relating to the system established by the Department and its working.

others he gave their tea, in order to obtain their attendance a sufficient time for completing their respective works. This is a pretty commentary on the system of paying by results men who are sent out as art missionaries in places where it is well known their exertions are very poorly appreciated, and where they are intended to raise the standard of taste.

We are glad to find that this novel system of payment is condemned by the Committee's report, for it is—as Mr. Potter, M.P., in giving evidence on the subject, truly remarks—an absurdity. It is acquiesced in by only one out of some ninety masters, and is, according to Sir Charles Eastlake, "calculated to induce a misdirection of the teaching, and a misapplication of study in the schools, with a view to the production of an imposing show of work."

With respect to the success of the schools the report is almost silent, the evidence taken on that point being so general as to be altogether unsatisfactory and inconclusive. The total number of students in 1863 were 87,330, of whom 71,423 were children of parochial schools; and the remaining 16,117 includes many youths of both sexes, who resort to the drawing classes merely because the teaching is cheaper, and, perhaps, better, than they could get elsewhere, but with not the most remote intention of applying their acquired skill to the improvement of our manufactures. The report says that "though a great many of the manufacturers are ready to declare themselves more or less satisfied of the value of the schools, their appreciation of them is not yet likely to carry them so far as to the point of supporting them by their subscriptions." In Manchester we find, from Mr. Potter's evidence, that the calico printers contributions have not, for the last thirty years, exceeded £200 annually for the support of the School of Art in that city, yet, to his knowledge, twelve houses annually pay from £25,000 to £30,000 for French designs. This says very little for the appreciation of the school in the metropolis of the manufacturing districts, and possibly, also, for the taste of the purchasers of the goods. But the fact cannot be hidden that, generally, the Schools of Art are not in favour, certainly not since the minutes of 1862 and 1863 were issued. Thus the withdrawal of the old grant from Belfast led to the abandonment of the school, and there is evidence that the like result will attend the Stoke-upon-Trent and Hanley Schools. Again, we find that at the recent distribution of prizes at Dublin the candidates, to the great surprise of the Lord Lieutenant who presided, were almost exclusively females; and that the judges have suggested for future competition "a list of subjects which, being of a more simple character than the works hitherto sent in, may have the effect of increasing competition in the various branches of the art."

This clearly indicates a falling off of power or interest in the students. Yet, notwithstanding these proofs of want of appreciation of the Government Schools of Art, we cannot but feel that they are effectually, although it may be slowly, doing their missionary work; for the works of the pupils exhibited at South Kensington give proof of great taste, if not originality in designing; and the manifest advancement in decorative art displayed by our manufacturers further shows that the recently acquired skill in designing has been practically applied. That much remains to be done is but too evident; for the highest class of decoration—symbolic art, the cultivation of which requires far more the exercise of the inventive faculty than the power of drawing,—is, so far as we are aware, ignored by the schools. Indeed, while there is no lack of works which give admirable examples of ornamentation—Mr. Owen Jones's *Grammar of Ornament* being in itself a storehouse—we know of no work that will materially aid the student of symbolic art, although there are evidences of a strong public leaning to that branch of decoration.

Of late, attempts have been made to establish, through the instrumentality of the Society of Arts, what its suggester has termed, an "Art Result Society," by the aid of which the designer and the workman are, as in the case of the painter, to be one and the same individual. The author of this proposed society, Mr. C. Bruce Allen, has, through the pages of the *Society of Arts Journal*, put forward his views; but they are of so hazy and untangible a character, although the intention is evidently good, that he has thus far, we believe, met with very little encouragement. He has come to a conclusion, and perhaps a right one, that our schools of art have not done all they might in qualifying wood carvers, glass painters, and others, to design for themselves; but in attempting to find a remedy for this, which time alone can provide, he has betrayed a lamentable ignorance of the province of decorative art,—confounding the imprinter of designs upon book covers with the artist who designed them; and also the works of the glass painter with those of the painter on canvas; whereas the close imitation of nature, which is the merit of the latter, is the demerit of the former.

To sum up the case of the Schools of Art, as exemplified by the report, we think that they deserve the hearty support of our manufacturers; and that, now that qualified masters are provided, the sooner they break away from the central authority, and modify their teaching to suit their respective localities, the better: for nothing can be worse than for an uniform system of teaching, on whatever subject, to pervade a whole country.

Recent Patents.

To ROBERT GRIFFITHS, *of Mornington-road, Regent's-park, for improvements in the construction of retorts or ovens for extracting oil from certain descriptions of cannel coal or other bituminous substances.*—[Dated 21st August, 1863.]

THIS invention relates to the construction of retorts or ovens, whereby a larger quantity and better quality of oil is produced from the cannel coal or other bituminous substances treated; the small or waste coal arising from working the coal in the mine being also more effectually vaporized.

In Plate II., fig. 1 is a longitudinal section of the oven for extracting coal oil. a, is the retort, of an oblong section transversely, about one foot deep by four feet wide, and about thirty feet long. The retort is built or fixed at such an angle and elevation, that when small coals are placed upon the upper end of the retort, they will slide down the sloping bottom a^1, thereof by their own gravity. At each end of the retort, doors a^2, and a^3, are fixed by screws or otherwise, for the purpose of filling and emptying the retorts; and pipes b, b^1, are provided for conducting away the vapours, formed by distillation, to the condensers. A furnace c, is constructed under the lower part of the retort a, which at this part is horizontal; and a slide or dividing plate d, is introduced between it and the inclined part a^1, of the retort, so that the contents of the horizontal part may be discharged, and then, by withdrawing the slide and allowing the coal to slide down the incline, be readily refilled. The flue c^1, of the furnace passes under the entire length and width of the retort, passing out, if desired, to a chimney at the top end thereof; or the flue may return over the top of the retort, as shown at c^2, and be conducted to a chimney c^3, placed in any convenient situation. A perforated shelf may, if desired, be introduced along the entire length of the retort, upon which part of the coal, or other bituminous material to be treated, may be deposited, so as to distribute the same over a larger area of heating surface. In place of making the inclined portion of the retort straight, as before described, it may be arranged at different angles in the course of its length. Each section or incline thus arranged has a slide to arrest the descent of the coals contained therein, so that the contents of each section may be allowed to descend in succession from one section to another, thus gradually subjecting the coal to a higher and higher temperature as it descends to the horizontal portion of the retort, from which it is removed when fully acted upon. Openings or doors are formed at each angle for the introduction of a poker or rake when required. Pipes are also applied for conducting the vapours away to the condensers as generated.

Another arrangement of retort, constructed according to this invention, is shown at figs. 2 and 3, and consists of a horizontal cylinder a, of iron or brickwork, of suitable size—say three feet diameter by eight or ten feet long, or thereabouts—and having an internal openwork cylinder or portion of a cylindrical cage b, of iron or perforated earthenware, supported therein, leaving an annular space c, between it and the interior of the retort, in which space the material to be treated is placed. At one end of this retort two doors, d, d^1, are placed, one above the

other, for supplying and discharging the contents; a pipe *e*, (or pipes) eing applied to the other end to conduct the vapours to the condenser in the ordinary manner. This retort may, if desired, be of round, oval, ◠, or other sectional shape, having shelves or cages inserted therein, with suitable doors for introducing the charge and discharging the contents in the ordinary manner. A furnace is constructed underneath at one end of the retort, with flues, to conduct the heat around the retort. In place of the open-work cylinder or cage *b*, a perforated shelf for supporting part of the charge may be introduced into the retort, by which a proportionate advantage may be obtained. Or the cylindrical retort may be placed in a vertical position, with an internal cylinder forming a central flue, and with cylindrical cages forming annular spaces in which the coal to be treated is placed. The flues from a furnace or furnaces are conducted through and around the interior and exterior of this arrangement of retort, so as to heat the surfaces exposed thereto. Suitable doors are arranged at the upper part, to introduce the cannel coal, or other bituminous material to be treated, and other doors are arranged near the bottom, to withdraw the coke as required; pipes are also applied for conducting the vapours, as generated, to the condensers. Suitable apparatus may be applied to this arrangement of retort to stir or agitate the contents, when required.

To WILLIAM TAYLOR, *of Shiffnal,* WILLIAM MOLINEUX, *of Hollinswood, and* HENRY HARRISON, *also of Hollinswood, Salop, for improvements in puddling furnaces for the manufacture of iron.*—[Dated 6th February, 1864.]

THIS invention consists in cooling the plates of puddling furnaces by the use of currents of cold air round the furnace. For this purpose the furnace is constructed in the usual manner, except that on each side of the puddling door an air chamber is employed. These chambers may be of any suitable dimensions and shape, and they are carried in opposite directions completely round the furnace, in such a manner, that they both meet at the rear of the furnace, the air from both chambers being discharged into the chimney. It will be seen from this description that two currents of cold air will be continually drawn in at the two mouths of the air chambers provided on each side of the puddler's door; that these two currents of cold air, by constantly passing round the furnace, will have the effect of cooling the same; and that the puddler will be in a great manner protected from those chemical effusions and noxious gases, arising from the puddling of the iron, to which he is now subject, in consequence of the tendency there will be for such effusions and gases, upon their escaping from the furnace door, to be drawn up one or other of the air chambers.

In Plate II., fig. 1 is a side elevation of the puddling furnace; fig. 2 is a section of the air chamber; and fig. 3 a sectional plan of the furnace at the line of the air chamber and through the firing holes. A, A, are the air chambers, a plan view of which is given in fig. 3, and which are shown in section in fig. 2. They are carried completely round the puddling furnace, except where the door is formed. The front ends of these chambers are open, and communicate with the atmosphere by two openings through the front furnace plates, which openings are on

either side of the puddler's door. An opening B, is also formed at the rear of the furnace leading into the flue C, which communicates with the chimney. A strong draught of air is thus caused to pass through the chamber A, in the direction of the arrows; the chamber being thereby kept sufficiently cool to prevent its destruction from the intense heat of the fire. Where, however, the hottest flame first touches the chamber, it is proposed to make the part D, separate from the body of the chamber, so as to be easily replaced when it has become reduced by the action of the fire.

The patentees claim, "the new parts above referred to, and generally the application of an air chamber or air chambers to puddling furnaces, substantially as described."

To JOHN THOMAS OAKLEY, *of Grange-road, Bermondsey, for improvements in vertical steam boilers or generators and the furnaces thereof.*—[Dated 6th February, 1864.]

THE object of this invention is to obtain a large amount of heating surface in steam boilers or generators without a complication of parts, and unequal wear of the boiler, and also to render repairing thereof easy; and further, to additionally expand the steam in the steam chest by superheating, which can be done without injury to the boiler.

The improvements in the furnaces of vertical steam boilers or generators consist, first, in a simple mode of hinging the bars to the furnace, whereby they may be readily got at to clear out clinkers, with but little loss of steam, and also for drawing and lighting the fire.

The figure in Plate I. is a transverse vertical section of the improved boiler or generator, and the furnace thereof set in brickwork. A, B, C, D, are four cases of wrought iron; those marked A, B, are formed cylindrical, and are connected together by rivets; E, is the top of the boiler, also rivetted to A; the cases C, and D, are formed conical, and are respectively connected to the case B, and plate B*, by rivets; and screw pipes and elbows *a*, and *b*, which serve as flues or ducts for the passage of heat from the furnace fires; G, G, is the water space; H, is a tube rivetted to the cases C, and D, for the admission of fuel, such opening being fitted with a furnace door; O, ash-hole; P, fire-bars, formed so as to project upwards within the case D, to prevent the fire burning the angle of the said case; *c*, is a bearing bar or rod; *d*, a crank fixed in a frame, upon which the boiler rests. The fire-bars hook on to the rod *c*, at one end, and are supported at their opposite ends by a cranked rod Q, the ends whereof are supported in the before-mentioned frame set in the brickwork; by turning the rod Q, on its axis, the bars P, may be dropped when required to draw the fire or to substitute new fire-bars. The outer case A, of the boiler is surrounded by brickwork R. Boilers or steam generators constructed as above described may be easily repaired without much loss of time, access being had to the inside thereof by a man-hole in the top E, of the boiler. Thus any of the tubes and elbows *a*, and *b*, may be quickly removed by unscrewing the nuts *e*, and fresh ones may be substituted in place thereof when necessary. The plate T, which covers the top of the flue U, may also, if desirable, be covered with brickwork.

The patentee claims, "the mechanical arrangement and combination of parts above described, as constituting improvements in steam boilers or generators, and the furnaces thereof."

To EDWARD WELCH, *of Wood Green, Tottenham, for improvements in tobacco-cutting machines.*—[Dated 8th February, 1864.]

THIS invention of improvements in tobacco-cutting machines relates to the action of the knife employed for cutting tobacco by machinery. Instead of the knife working perpendicularly to the tobacco, and cutting by pressure only, the patentee gives a drawing cut motion to the knife, whose edge at the same time is not subjected to contact with the surface supporting the tobacco, or with any substance except the material to be cut.

In Plate II., fig. 1 represents a front elevation of a tobacco-cutting machine constructed according to the invention. A, is the reciprocating knife, which is usually mounted on a fixed fulcrum at B, but which in this case is mounted on the end of a lever C: this lever C, is mounted on a fixed pin D, on which it oscillates to the extent indicated by the dotted positions. It is connected at the lower end E, to an excentric rod F, which rod is actuated by an excentric placed on the main shaft G, of the machine. The excentric imparts a to-and-fro motion to the rod F, at each revolution of the shaft G, and, consequently, an oscillating movement to the lever C. The opposite end of the knife A, has an up-and-down motion communicated to it by a connecting rod H, from a crank pin in the plate I, fixed on the shaft G, in the ordinary manner. *a*, *a*, is the cutting edge or mouth of the bed, over which the tobacco is projected and fed up to the cut. It will be evident, that while the knife A, is descending by the oscillatory motion imparted to the lever C, the fulcrum B, on which the knife moves, will travel from the point 1 to the point 2, and that therefore the edge of the knife will traverse across the tobacco to the same extent simultaneously with, and while it is performing, its descending cutting motion, thereby producing a drawing cut while severing the tobacco into shreds as required. In this way the knife will cut much cleaner, the shreds severed will be finer, and will present a better appearance than when cut by the ordinary machines, and at the same time creating less waste of the tobacco in what is termed "smalls."

Fig. 2 represents a front view, and fig. 3, a partial vertical section, of a machine, showing another mode of imparting a drawing cut to the knife, which in this case is obtained by moving the knife in an inclined direction to the bed or mouth from which the mass is projected. In general appearance this machine differs much from ordinary machines, but the difference is mostly in the framework and knife carrier; the feeding rolls and gear for actuating the same, together with the bed or mouth, being made as usual. L, L, is the framework of the machine. Behind the front uprights of the framing L, the knife frame M, is fitted, so as to slide in the inclined direction indicated, the whole being of cast iron, and fitted to move freely and steadily in dovetailed guides or grooves Q, Q. The knife frame is in the form of three sides of a parallelogram, with an arched top over the middle side, from which point it is driven. The knife P, is fixed on the upper side on the front of the frame M, with its

bevilled edge in front, the flat side being at the back and against the mouth R, of the machine; this mouth has a lower cutting face or bar, against which the knife P, cuts as usual. S, is the lower and large feeding roller, and T, the small upper ones, driven by the spur wheel and pinion U. An endless screw V, communicates the motion received from the first mover of the machine by ratchet and pawl gear as usual. The knife, as before mentioned, is driven from the top, having a pin W, fixed in it, on which the upper end of a double connecting rod X, X, takes; the lower part of the connecting rod X, is actuated by a crank Y, to which it is attached; the rotation of the crank transmitting and producing the reciprocating motion of the knife frame M, and knife P, as desired.

The material is fed between the rollers S, and T, and projected a little at the mouth R, between each cut of the knife, so that the descent of the knife severs the quantity so projected. The direction of motion of the cutting edge of the knife being lateral as well as in the downward direction, the cutting edge will be drawn across the tobacco at the same time it is descending through it, and so produce the clean drawing cut desired.

The patentee claims, "the arrangement of parts hereinbefore described, constituting a machine or machines for producing a drawing cut in the knives of tobacco-cutting machines, or any mere mechanical equivalents thereof."

To WILLIAM HAWTHORN, *of Newcastle-upon-Tyne, for improvements in joints for pipes, tubes, and hollow vessels.*—[Dated 10th February, 1864.]

THIS invention relates to a peculiar self-closing or self-tightening joint for closing the ends of pipes or tubes, or the mouths of hollow vessels during the operation of testing the same under high pressure, whether such pressure be obtained from steam, air, gases, or liquids, and is also applicable in all cases where a perfectly tight joint is required under very high pressures.

The figure in Plate II. is a partial sectional plan of a tube testing machine, illustrating the application of the improved joint thereto. A, is the pipe to be tested, which is placed at each end in the metal sockets B, B^1, screwed into the cross bars C, C^1. One of these cross bars C^1 is made to slide along the slide rods D, D, so as to be capable of accommodating various lengths of pipes, the adjustment being effected by a screw spindle and hand-wheel, or by any other equivalent mechanical device. Each of the sockets B, B^1, is fitted internally with an india-rubber, leather, gutta-percha, or other flexible or elastic ring or washer E, which fits nicely into the inside diameter of the pipe A. The water or other fluid used for testing is introduced through the small channel *a*, and expands the washer E, close round the joint, thereby making such joint perfectly tight under any pressure which may be applied. The air contained in the pipe is discharged by a small cock fitted to one of the sockets, and the pressure gauge may be fixed either on to one of the sockets or on to the force pump employed.

The patentee claims, "Firstly, the peculiar construction of joint for pipes, tubes, and hollow vessels intended to withstand pressure, as de-

scribed. Secondly,—the combination of a collar, ring, washer, or ferrule of flexible or elastic material, with a metal socket, in the manner and for the purposes described."

To HENRY WALKER WOOD, *of Blackweir Glamorganshire, for improvements in cylinders exposed to the direct action of fire, and employed in the manufacture of artificial fuel, and in heating and drying other substances.*—[Dated 15th February, 1864.]

THIS invention consists in constructing the lower part of the cylinders open over so much of the extent thereof as is liable to injury from the fire, in forming flanges round the opening, and in fixing in the opening one metal plate, or several separate metal plates; on any one or more of these plates becoming worn, it or they can be readily removed and replaced, without the necessity for removing the cylinder.

The figure in Plate I. is a transverse section of a drying cylinder, fitted according to this invention; *c*, is the cylinder, having a portion of the lower part formed open, and provided with a flange or flanges *d*, *d*, round the opening. A metal plate or plates *e*, *e*, are inserted into the open part, and rest upon the flanges *d*, *d*. When worn or burnt by the action of the fire, the plates are removed and others substituted for them, and that without necessitating the removal of the cylinder.

The patentee claims, "constructing cylinders exposed to the direct action of fire, and employed in the manufacture of artificial fuel; and in heating and drying other substances with one or more bottom plates capable of removal and replacement, as described."

To ROBERT CHARLES RANSOME, ROBERT JAMES RANSOME, *and* JAMES EDWARD RANSOME, *all of Ipswich, for improvements in the manufacture of beams, mould boards, and shares of ploughs.*—[Dated 18th February, 1864.]

THIS invention consists, firstly, in the manufacture of the beams of ploughs of malleable cast iron, by casting them of the desired forms and sections and then converting them by the process of cementation. It is preferred that a plough beam should be hollow, and of a rectangular transverse section, but such form is not essential, as other transverse sections may be employed, and some parts of a beam may be of different transverse sections and of different thicknesses of metal to other parts. If desired, different degrees of hardness may be obtained at any particular parts of a beam, at the same time that the malleability of other parts is retained. These advantages cannot be obtained when making beams of ordinary cast iron, nor can such advantages be obtained except at great cost when using sheet iron or sheet steel.

Secondly, the invention consists in the manufacture of the mould boards of ploughs of malleable cast iron, by casting them of the desired forms and then converting them by the process of cementation.

Thirdly, the invention consists in the manufacture of the shares for ploughs of malleable cast iron, by casting shares of the desired forms and afterwards converting them by the process of cementation. The

cutting edges of such shares are heated and quenched (by preference in sea-water), by which means the boxes or sockets, or hinder parts, are retained malleable, whilst the cutting parts are rendered very hard. In some cases, ploughshares have separate cutting edges, in which cases the boxes or sockets, or hinder parts, are manufactured of malleable cast-iron, as above described, and any suitable separate cutting edges are used therewith.

In Plate I., fig. 1 is a side elevation of a portion of a plough, in which *a*, is the beam; *b*, is the body; *c*, the handles; *d*, the head; *e*, *e*, projections formed on the beam *a*, for receiving the wheel fastenings; and *f*, is a socket also formed on the beam *a*, for receiving the coulter. It is preferred to employ a beam which is hollow and of a rectangular transverse section, as at fig. 3, but such form is not essential, as other transverse sections and other shapes of beams may be made according to this invention. Figs. 2, 4, and 5 show other transverse sections of beams, or parts of a beam, as some parts of a beam may be of different transverse sections, and by reason of the beams being cast, they may be readily made of different thicknesses of metal at different parts, according as the parts are subject to more or less strain in use. The head *d*, is shown as a separate piece fixed into the end of the beam, but it is obvious that this part may be formed in one piece with the beam. In manufacturing plough beams, the patentees cast them of suitable cast iron and of the desired forms, and then convert and render them malleable by the process of cementation.

Fig. 6 is a side elevation of a mould board of a form now much used, and is shown merely to illustrate the application of the invention to the manufacture of mould boards in general. It is found that in some forms of mould boards the front or part at or about *x*, is exposed to more wear than the other parts, and again in other forms of mould boards the greatest amount of wear will be at or about the part *y*. In manufacturing mould boards, the patentees cast them of the desired form of suitable iron, and then convert them by the process of cementation into malleable iron, and when it is required that different parts should be of different hardness, such parts are heated and quenched, by preference in sea-water.

Fig. 7 is a plan of a ploughshare of malleable cast iron, in which the cutting edge *v*, is hardened by heating and quenching, as above described, being rendered thereby very hard and durable, while the box or socket *w*, is malleable and not liable to be broken; the cutting edge *v*, of these shares, when worn by use, may be drawn out by being heated and forged, and then re-hardened in the same manner as that practised when using wrought-iron shares with steel cutting edges.

Fig. 8 is a plan of a ploughshare, in which the box or part *w*, is made of malleable cast iron, and the cutting edge *v*, is attached thereto by rivets or otherwise. According to this invention, shares of the desired forms are cast of proper iron, and are then converted into malleable iron by the process of cementation.

The patentees claim, "the manufacture of plough beams, also the mould boards of ploughs, and also ploughshares by the combined processes of casting and cementation, with or without hardening, as herein described.

To GEORGE HANDEL OPENSHAW, *of Over Darwen, Lancashire, for certain improvements in power looms for weaving.*—[Dated 16th March, 1864.]

THIS invention relates, first, to that part of the power loom known as the "warp beam," and is designed for the purpose of placing the required amount of friction upon the beam without the use of weights as hitherto employed.

The improvements consist, first, in the application and use of a long laminated or plate spring (similar to a coach spring), which is attached, in the form of an arch, to a bar on the framing of the loom immediately beneath the beam; the ordinary ropes or bands which pass round each end of the warp beam being attached, by means of a screw and nut, to the ends of the spring, so that the usual weights are dispensed with, the tension on the warp being regulated by the screw and nut.

A second part of the invention relates to a novel means of imparting an even tension to the warp as the healds rise and fall, and consists in the use of an excentric on the crank shaft, which is connected with arms carrying a rod or bar on which the warp bears, so that as the excentric rotates, it causes the rod to move to and fro, thereby giving an even tension to the yarn by taking up the slack, and *vice versâ*, to compensate for the rise and fall of the healds.

In Plate I., fig. 1 represents that portion of a loom where the warp beam is situated, and fig. 2 represents a side elevation of a part of a loom, showing the end of the tension spring and apparatus for tightening or loosening it, and also the excentric on the crank shaft for equalizing the tension on the warp by compensating for the rise and fall of the healds.

In fig. 1, *a*, *a*, is the framing of the loom to which the laminated or plate spring *b*, is secured, in the position and by the means shown; *c*, is the warp beam, around the ends of which the rope or band *d*, is coiled as usual, the lower ends of which are connected to a screwed rod, which passes through the ends of the spring, and is tightened or slackened by means of the wheel nut *e*, the tension being entirely removed from the beam by disconnecting the spring from the rope. In fig. 2, e^1, is the crank shaft, on which are the excentrics *f*, *f*, which are encircled by clips *g*, *g*, carrying the arms *h*, *h*, whereby the tension bar or rod *i*, is supported. As the crank shaft rotates, the excentrics cause the said bar to advance and retire, or rise and fall, according to the rise and fall of the healds, and by thus compensating for the motion of the healds, the warp is kept at a regular tension.

The patentee claims, "First,—the application and use of a laminated or plate spring (similar to a coach spring) to looms, for the purpose of regulating the tension of the warp. And, Secondly,—imparting a reciprocating or rise-and-fall movement to the tension bar over which the warp passes, by means of excentrics, or their mechanical equivalents, on the crank shaft, so as to compensate for the action of the healds and keep the warp at an even tension, as described."

To Samuel Berrisford, *of Stockport, and* William Ainsworth, *of the same place, for certain improvements in looms for weaving.*— [Dated 22nd March, 1864.]

This invention relates to looms having a series of moveable shuttle boxes, and to means for bringing the shuttles by self-acting arrangements opposite the shuttle race in the order required to produce the pattern of the fabric to be woven; and the improvements consist of a new combination and arrangement of mechanism for this purpose.

In Plate I., fig. 1 is a side elevation of so much of a loom as will be necessary for explaining the manner in which the invention is carried into effect; fig. 2 is a detached view of some of the parts shown in fig. 1, but at a right angle thereto; and fig. 3 is a sectional view of some of the parts shown in fig. 2.

A, is a side frame of the loom; *a*, the crank shaft; *b*, tappet shaft; *c*, the slay, with shuttle boxes c^1, moveable in a vertical direction by means of a rod c^2, and chain c^3, secured to a pulley c^4, on a stud c^5, fixed in the framing; these parts are ordinary parts of a loom arranged in the usual manner. The pulley c^4, receives oscillatory motion by means of a chain d^1, the ends of which are secured to its periphery and to the periphery of a pulley, which is free to rotate on a stud d^2, fixed in the side frame; and the pulley is secured to, or forms part of, a star wheel *d*, on the same axis d^2, and this star wheel receives motion from a pin and disc arrangement centred upon the tappet shaft *b*; the parts on this shaft will be best understood by reference to fig. 3. *e*, is a wheel which is free to rotate on the tappet shaft *b*, but is kept in position endways by the bearing of the tappet shaft on one side, and a collar b^1, keyed on the tappet shaft on the other side. The wheel *e*, receives motion at the same speed as the tappet shaft, but in the opposite direction from a wheel e^1, on the crank shaft, and by an intermediate wheel e^2, on a stud in the framing; the wheels being represented by dotted pitch lines. The disc *g*, of the pin part is free to rotate on the tappet shaft. It has a long boss which comes against the fixed collar b^1, at one end and another fixed collar b^2, at the other end. Upon the boss of the disc *g*, a clutch arrangement *h*, is placed; it has a projection h^2, which passes over the fixed collar b^1, and so as to reach into a hole cut out of the disc part of the wheel *e*; it has also a part projecting towards the axis of the shaft which can enter a notch cut out of the fixed collar b^1, when the clutch is slidden in that direction. This clutch *h*, has also another projection h^2, which passes through a hole in the disc part *g*, so that the disc and clutch part rotate together in every position of the clutch. When the clutch is in the position shown in fig. 3, the disc *g*, is in gear with the wheel *e*; when pushed in the opposite direction, the projection enters the notch in the fixed collar b^1, and the disc is then in gear with the tappet shaft. The pin part g^1, is detached from the disc *g*, and is mounted on a boss g^2, which can be slidden endways freely, and by this means one or more of the teeth or pins, which are of different lengths, can be brought opposite the star wheel *d*, according to the extent of movement required in the shuttle boxes. The clutch *h*, and pin part g^1, are moved by bell-crank levers h^3, and g^3, having their fulcrums on studs secured in a bracket A^1, from the end frame of the loom. These bell-crank levers have each a pin in one arm, which

enters the groove in the clutch h and the pin part g^1, the other arm of each lever being jointed with a rod h^4, and g^4; and the upper end of each rod is jointed with a lever h^5, or g^5, having its fulcrum on a stud h^6, in the framing. Each lever carries a bowl that rests upon the links of an endless tappet chain h^7, which passes round a pulley on a stud h^8, in the framing, and this pulley is secured to, or forms part of, an ordinary star wheel or intermittent motion k; the pin disc k^1 being fixed on a stud in the framing, and driven by a wheel on the crank shaft. This arrangement of chain tappets is ordinary and well known. The chain tappets act to cause the disc part g, to rotate one way or the other, and to cause the pin part g^1, to bring one or more pins or teeth opposite the star wheel d, as required.

The patentees claim, "the combination and arrangement of mechanism described and illustrated for actuating shuttle boxes in looms for weaving, and particularly the use of an intermittent motion with two or more pins or teeth of different lengths, so that, by moving the same in the direction of its axis of rotation, one or more pins may be made to act upon the star wheel at each revolution of the pin part, as described."

To HUGH HOLDEN *and* ENOCH SAMUEL FORSHAW, *of Preston, for improvements in looms for weaving.*—[Dated 29th March, 1864.]

THIS invention relates to the self-acting break mechanism of looms, and also to the weft fork.

In Plate I., fig. 1 represents a side elevation of a portion of a power loom fitted with a sliding "frog," and having the improved self-acting weft break apparatus applied thereto. A, represents the main framing of the loom; and B, the crank shaft, provided with the usual break wheel C; D, is the break, which works on a stud, centre, or bolt E, secured to the main framing at the driving end of the loom; F, is a concussion break lever; and G, the weft break lever, shown in plan at fig. 2; the former F, being rigidly secured to a lug a, cast on the break, whilst the latter lever G, is allowed to work freely on the bolt E, as a fixed centre. This lever G, has a step or shoulder formed upon it at b, which bears against a corresponding part formed upon the break, so that when the front end of this lever is depressed, it causes the break d, to turn slightly upon its centre or bolt E, and to be applied against the rim of the break wheel, thereby stopping the revolution of the crank shaft. As the weft break lever works loose upon the bolt E, it allows the concussion lever, with the break to which it is attached, to be brought into action a little before the weft break lever G, is acted upon; but by the time the concussion break lever F, has been fully depressed or brought into action, the weft break lever G, is released and drawn down by the weight H, suspended therefrom, and consequently the breaking action of the concussion break lever F, is assisted and increased by the weight H; I, is the sliding frog (if preferred, the ordinary spring frogs may be used), which works along the top of the rail A^1, of the main framing; it extends down the inner side of the rail A^1, and has at this part two guiding snugs cast thereon, which work in a slot d, made in the framing. On the outer side of this rail A^1, there is a notched washer plate K, the notches of which fit on to the ends of the

snugs. A bolt or pin passes through the plate K, through the slot in the rail A^1, and through the extended portion of the frog on the inner side of the rail A^1, thereby serving to secure the plate K, in its place. The head of this bolt is prolonged so as to form a pin *e*, projecting laterally some distance beyond the face of the plate K. Immediately under this pin *e*, is situate the concussion lever F, the end of which is inclined upwards, as shown, so that when the frog with the pin *e*, is moved forward by the usual mechanism, which is brought into play when the shuttle does not box properly, as shown in fig. 1, the pin *e*, will, by sliding along the inclined end of the concussion lever, depress that lever, and so apply the break. Immediately after this movement has been effected, the weft break lever is released and brought into action. This is accomplished by means of the arm L^1, cast in one piece with the frog, which arm, when the frog is pushed forward, strikes against the head of an adjustable screw pin M, fitted into the ordinary spring handle N, and consequently releases that handle from its detaining notch, and allows the free end of the weft break lever G, to descend and assist by its weight in applying the break. The free end of this lever G, is supported upon an inclined bracket O, fig. 3, fitted to the spring handle N, so as to be adjustable thereon; and to this bracket is pivotted excentrically the piece of metal *f*. By pivotting this piece *f*, excentrically, so as to give greater weight to the lower portion thereof, it always assumes a vertical position when at rest, and serves, when in that position, as a prop or support for keeping the end of the weft break lever elevated when the spring handle is released from its retaining notch, and consequently the break remains out of contact with the break wheel, as the weight of the break head itself causes it to hang some little distance below the periphery of such wheel. In this position the loom is free to be turned by hand when required. So long as the spring handle is held back in its retaining notch, the end of the weft break lever is supported and kept elevated by the higher portion of the incline *g*, on the bracket O; but so soon as the spring handle is released from its retaining notch, it moves in the direction of the arrow, carrying with it the inclined bracket O; and consequently the end of the weft break lever descends to nearly the bottom of the incline *g*, pushing to one side the excentric piece *f*, as shown in dotted lines, and by its descent applies the break, the weight H, giving the necessary pressure.

Fig. 4 represents a sectional plan of a weft fork, constructed according to this invention, the fork P, being hinged or pivotted upon a tapered pin *h*, in lieu of upon a parallel rivetted pin as heretofore. One or both ends of this pin are screwed parallel, a short distance down, as shown at *i*, in the detail fig. 5; these screwed portions passing through the jaws in the supporting rod Q. By screwing this pin forwards or backwards, it may be made to fit with the greatest accuracy into the hole or socket in the fork, such hole being tapered to correspond to the taper of the pin, and consequently all undue looseness or shaking of the fork is obviated.

The patentees claim, "First,—the general construction and arrangement of the break-actuating mechanism of power looms, as described. Second,—the combination of a concussion break lever and a weft break lever with one front break, the whole being arranged and made to

operate in the manner and for the purpose described. Third,—the application and use of the peculiar solid bracket or support for the weft break lever attached to the spring handle of a power loom, for the purpose described. Fourth,—the application and use of the excentric bracket or support *f*, for the purpose described. Fifth,—the application and use to and in the weft forks of power looms of a tapered joint, pin, or pivot, having one or both of its ends screwed parallel for a short distance, for the purpose described."

To PETER BERGHAUS, *of Wichlinghausen, near Barmen, Prussia, for improvements in the manufacture of ribbons, and in the machinery or apparatus used in such manufacture.*—[Dated 21st March, 1864.]

THIS invention consists principally in manufacturing ribbons in a peculiar form, applicable specially to the formation of collars, cuffs, and other articles, and trimmings for ladies' dress. The ribbon, instead of being woven in a straight strip, as hitherto invariably practised, is woven in a coil or helical form, so that all that is necessary to form a collar or cuff of such ribbon is to cut off the required length and hem or bind the ends. The ribbons are woven in the ordinary ribbon weaving loom, but instead of being wound on to a straight or parallel work beam or roller as usual, each ribbon passes through a pair of conical fluted rollers, which are driven at the proper speed to take up the work as it is woven, the rollers being pressed together by weighted levers. It will be evident, that as the weaving proceeds, that edge of the ribbon which passes between the larger diameters of the rollers will be advanced quicker than the other edge which passes between their smaller diameters, and hence the ribbon, instead of being straight, will be woven in a circle, and will hang down in front of the rollers in a coil or helix, the radius of the curve given to the ribbon being determined by the amount of taper given to the rollers.

The figure in Plate I. represents a front elevation of the improved machinery employed for the purposes of this invention. *a, a*, are a pair of conical fluted rollers, mounted in suitable standards *b, b*, which are fixed to the breast beam of the ribbon loom, one pair of these rollers being placed in front of each division of the loom. The rollers a, a^1, are geared together by spur teeth *c, c*, and the axle of the lower roller is provided with a spur wheel *d, d*, driven by a similar wheel *e, e*, keyed upon the driving shaft *f, f*, which extends the whole breadth of the loom, and actuates all the conical fluted rollers, it being supported in suitable bearings *g, g*. The upper roller *a*, is kept in firm contact with the lower one a^1, by means of weighted levers *h, h*, which press upon the brasses or bearings that carry the axle of the upper roller.

The patentee claims, "Firstly,—the novel mode of manufacturing ribbons in a continuous curve, as above described. And, Secondly,—the employment of the conical work rollers in pairs (whether fluted or otherwise), in the manner and for the purpose set forth."

To Richard Archibald Brooman, *of Fleet-street, for an improved method of, and improved apparatus for, revivifying animal black.—being a communication.*—[Dated 26th March, 1864.]

This invention consists in progressively drying and heating animal black until revivified, and then in cooling the same; and the improved apparatus consists of an oven with retorts placed horizontally, and superposed; the fire being inside the lower retort, and the upper retort heated by flues from the lower retort. The top of the apparatus serves for drying the black, and it is progressively heated by passing through passages provided for that purpose around the upper retort and between it and the flues surrounding it, and then around the lower retort and its flues. On leaving this passage, the black is revivified, and continues on into a cooling chamber furnished with cold air flues, and traversed by air pipes below the lower retort. At the bottom of this chamber, doors are provided, through which the revivified black is withdrawn. The retorts may be made either with single sides, and with external plates to form the passages through which the black passes, or they may be made with double sides without external plates, in which case the black passes through the passages formed by the two sides.

In Plate I., fig. 1 is a vertical section taken through two horizontal superposed retorts of an apparatus constructed according to this invention. In this arrangement the retorts have only single sides. Fig. 2 is a transverse vertical section of a similar apparatus, with the retorts formed with double sides; fig. 3 is a longitudinal vertical section, through the line 1 and 2 of fig. 2. A, is the lower retort, which receives the flame and products of combustion from the fire-places (fig. 3); B, B, figs. 1 and 2, are flues into which the products of combustion pass from the retort A; C, C^1, are plates or divisions of iron, or of refractory material, forming one side of the flues. In the arrangement represented in figs. 2 and 3, these plates are replaced by the second or double side of the retorts. D, is the upper retort, which is heated by the products of combustion passing through the flues B, B, and E, E; F, F, are other flues in which the products of combustion circulate before passing off into the chimney G; these flues heat the top H, of the apparatus on which the animal black to be revivified becomes dried before being heated in the apparatus, as about to be described. The black is introduced into the apparatus by the orifices I, and becomes progressively heated in passing down through the passages J, J, and L, L; by the time it reaches the bottom of the passages L, L, it has become sufficiently heated to effect its revivification, it then falls into a cooling chamber M, surrounded with cold air flues N, N. O, O, are plates, with doors P, through which the revivified black is withdrawn; Q, Q, are passages for waggons for carrying away the black as it leaves the chamber M; R, R, are air pipes (of which there may be one or more) terminating in the fire-place, and through which a current of cold air is kept up by the draught through the fire.

The patentee claims, "Firstly,—constructing apparatus for revivifying animal black, in which the drying and heating of the black, until revivified, are performed progressively in passages surrounding the re-

torts, and in which the black, after revivification, is cooled in a cooling chamber, all substantially in manner described. Secondly,—constructing apparatus for revivifying animal black with two horizontal superposed retorts, the interior of the lower of which is submitted to the action of the fire, as described."

To JOHN JAMES LUNDY, *of Leith, and* ROBERT IRVINE, *of Musselburgh, North Britain, for improvements in the manufacture of paper.*—[Dated 1st April, 1864.]

THIS invention relates to the application and use, in the manufacture of paper, of certain natural products or chemical compounds, for the purpose of imparting to the manufactured product a hard, smooth, and firm surface.

One improvement consists in the use of the silicates of magnesia in the manufacture of paper, commercially known under the names of talc and steatites or soapstones. These materials, after being finely powdered or levigated with water, are used in the manufacture of paper, in suitable proportions for producing the required smoothness of surface.

A similar result may also be obtained by the application and use of the silicates of lime, or by the combination of two or more substances which will produce these silicates, and serve to retain them in the paper when mixed with the pulp during the process of manufacture. The silicate of lime or the silicate of magnesia, or the two combined, may be mixed with farina, starch, or with the size used in paper-making. Or, in lieu of this combination, the silicates may be mixed, prior to being used, with finely-powdered alabaster or gypsum, and known commercially as "mineral white," "pearl white," "terra alba," or with "pearl hardening," to produce the desired result. By these means a very superior finish is imparted to the manufactured product.

The invention is not confined to the sole use of the silicates of magnesia and silicates of lime above named, but analogous silicates, such as asbestos, greenstone, hornblende, mica, serpentine, or other similar substances, whether used after pulverising or levigation, mixed or unmixed with farina, starch, size, gypsum, alabaster, mineral white, pearl white, terra alba, or pearl hardening may be used. The quantity of these substances which give the best result in practice are from fifteen to twenty per cent. of the paper produced.

The patentees claim, "the application of the hereinbefore mentioned substances to the manufacture of paper, the quantity to be used varying with the thickness and smoothness desired."

To RICHARD JOHN EDWARDS, *of Bow, Middlesex, for improvements in the mode of toughening papers and other substances, to render them suitable for the application of abrasive substances, and for other purposes, and in apparatus used in such manufacture.*—[Dated 2nd April, 1864.]

IN order to toughen paper and other fabrics, to adapt them to receive abrasive substances, the patentee places fibrous substances between

two or more layers or thicknesses of paper or other substances, not previously carded or spun. The substances preferred for this purpose are manilla, jute, the inner bark of trees, the fibrous portions of vegetables, leaves of plants, grasses, wood shavings, and such like..

In order to prepare the inner bark of trees, they are split into minute shreds, in the following manner:—A number of exquisitely thin steel knives, or very fine round steel blades or wire, are placed in a framework fixed on a table; then a piece of the inner bark is placed upon the knives or wire blades and drawn along the knives, which operation produces shreds of a uniform width or thickness, according to the distance at which the knives are set apart. The manilla, or jute, or the shreds of the inner bark of trees, the patentee stretches upon frames, and whilst secured thereto he applies sheets of paper on each side of the fibrous substances, the paper having been previously coated with a glutinous or adhesive substance; he then cuts the fibrous substance away at the edge of the paper, and so sets at liberty from the frame the paper and fibrous substances. The papers thus toughened are placed in a screw, hydraulic, or other press, and subjected to considerable pressure while in a wet state, between wirework, or india-rubber, or gutta-percha, previously indented on one side, and a plain metal plate on the other side of the sheet, for the purpose of giving a flat surface to one side, and giving the material the appearance of cloth on the other side. After being in the press a short time, say fifteen minutes, the sheets are removed and hung up to dry. When dry they are taken down, and the edges are trimmed. The paper so prepared and toughened is, when required to be used for letter envelopes or writing surfaces, usually calendered.

Another mode of carrying out the invention is, to weave the shreds produced, as before described, from the inner bark of trees, into a cloth or fabric, and to place one or more sheets of paper, previously coated with gluten or other adhesive substance, on each side of the fabric so produced, and to pass the whole between rollers to produce the compression, and then over steam cylinders to dry.

According to another mode, the patentee grinds up fibrous substances, and distributes them on paper previously charged with a glutinous substance. He then passes the material so prepared between iron cylinders, and hangs it up, or passes it over steam or other heated surfaces to dry.

The frames on which the various fibrous substances are stretched are so constructed as to admit of a series of small metal plates being inserted in grooves made in the frame. Some of these plates are indented or engraved on their surface, others of them being covered with india-rubber or other elastic substance. These plates vary in thickness, according to the distance at which the toughening material is to be inserted between the plates, and are held apart until the paper or other material is placed upon the shreds or strings forming the toughening material. The indented or engraved plates, and those covered with india-rubber or other elastic substance, are held in an upright position in the frames by means of screws or springs fixed in the frames, which are tightened by turning the screws so as to hold the shreds or strings of toughening material in tension whilst the paper or other material is applied. Cotton or other fibres, or pulped substances to be felted

together, may be strengthened in like manner, by immersing the frames with the shreds upon them, in liquid pulp,—taking up upon the shreds the desired quantity of pulp to form a sheet of paper or material upon and intermixed with the shreds.

To WILLIAM HOLBROOK, *of Duke-street, Bloomsbury, for improvements in apparatus for hair brushing.*—[Dated the 31st March, 1864.]

IN constructing apparatus for brushing hair, according to this invention, the brushes are formed of a series or rows of bristles, of any desired number, on a circular or polygonal hollow shaft set between two quilled handles, one of which contains a spiral spring, enclosing and being fixed to a spindle, the continuation of the spindle passing through the centre of the brush, and fitting the square or other bore thereof; the other end of the spindle is provided with a screw thread, on to which the opposite handle is attached. Or, in lieu of the spiral spring in the handle, a narrow helical or spiral spring may be enclosed in a circular box at the end of the brush, between it and the handle. In both cases, to wind up the springs, it will be necessary to use a ratchet wheel and pawl, so that the springs may be wound up, and the brush placed on one side ready for use. When it is desired to apply the brush, it is held by both handles, and the pawl is disengaged by means of a thumb-piece, in order to afford rotary motion to the brush; the speed being controlled by a friction break, actuated by the hand of the operator. The handles may be made of thin metal, for the sake of strength and lightness; and where the spring is contained in a box, such box may be prolonged, in order to enclose a series of toothed wheels similar to clockwork, for the purpose of regulating the rotary motion of the brush.

The patentee claims, "the method of actuating rotating or revolving hair brushes by the application of springs in combination with regulating wheels, as described."

To DANIEL WEST, *of Egremont-place, Euston-road, for improvements in fire-proof railway vans, trucks, and carriages, and in fire-proof cases for the reception of goods or merchandize to be conveyed by railway.*—[Dated 13th May, 1864.]

THE object of this invention is to provide a safe means of conveyance upon railways for combustible goods or merchandize. To this end, the patentee constructs closed vans or carriages of sheet or plate iron, copper, zinc, or other metal sufficiently thin to secure lightness, in which vehicles the goods may be readily packed, and from which they may as readily be discharged. He also constructs fire-proof metal cases for containing goods or merchandize, to be transported on railways, and fitted upon railway trucks provided to receive them, and by this means secures the goods from accident by fire.

In Plate II., fig. 1 is a side elevation, partly in section, of the improved fire-proof van. *a*, *a*, are plates of sheet metal (which may be corrugated instead of flat, to give increased strength to the structure, if thought desirable), forming the sides and ends of the van. These

plates are connected together by being rivetted at their edges to vertical and transverse bars of iron *b*, *b*; and at the angles angle-bar iron *c*, *c*, is employed for connecting, by means of rivets, the sides and ends together and to the frame or floor *d*, of the van. For convenience, the sides and ends of the van may be composed of detachable panels or pieces fastened together at the four angles of the body, and at their edges by bolts and nuts; so that when separate, they would lie in small compass, and upon being conveyed to a distant place may be readily fastened together to form the body. The roof or top of the van is formed of curved metal plates *e*, *e*, the edges of which overlap the one the other, as shown. The ends of these plates are secured by bolts and nuts to longitudinal angle iron bars, and the end plates *e**, *e**, are further secured by bolting them to a curved angle-iron rib *g*, affixed to the ends of the van at the upper edge thereof. This arrangement admits of the roof being opened by the removal of sections of the covering plates, for the admission of the goods which may require (as in the case of cotton, hemp, or other fibre, not previously formed into bales) being packed tightly, to be trampled into a compact mass. Internal stays or rods of iron, from side to side, would sustain the expansive pressure from within, caused by treading the goods compactly down. In the sides of the van, hinged doors *h*, *h*, are provided, or it may be sliding doors or shutters, which are to be securely closed and fastened when the van is laden, and may be used for removing the goods when they have arrived at their destination.

Fig. 2 shows, in side elevation, a truck fitted with a series of fire-proof cases, according to the second part of the invention. The cases may be of any convenient form suitable for the reception of the goods or merchandize intended to be transmitted from place to place. They are made cylindrical, and of sheet iron, or other metal, rivetted together. At the upper end of these cases *i*, *i*, are lugs *i**, which project through slots cut in metal covers *k*; and bars *l*, passed through the lugs, serve to secure the covers in their places. According to the different sizes of these cylindrical, square, or other shaped cases, a given number of them would contain the full and proper load, in tons, for a van, truck, or carriage, the dimensions of which might be larger or smaller, to suit particular convenience. The cases being filled with goods, previously to their being loaded for conveyance, are to be placed on the floor of the carriage, and, by means of a protecting chain *m*, supported by standards *n*, from the carriage frame, the cases will be maintained in position during the transit. Cleats can be fixed on the floor to prevent the cases from moving.

The patentee claims, "constructing fire-proof railway vans, trucks, and carriages, and cases for the reception of goods or merchandize, in the manner described."

To GEORGE PARRY, *of the Ebbw Vale Iron Works, Monmouthshire, for improvements in the treatment of slag, or the cinder of blast furnaces, for the purpose of utilizing the same.*—[Dated 25th February, 1864.]

THE object of this invention is to utilize the slag or cinder obtained from blast furnaces, in a more economical manner than heretofore. In preparing it for use, it has been usual to reduce the slag or cinder

from the blocks (in which form it solidifies) to powder, by means of stampers or mills, which process is very expensive, by reason of the power consumed in the operation. To effect an economy in the reduction of the slag or cinder, it is proposed to apply, below the shute or gutter along which it runs from the furnace, jets of steam, or superheated steam; or jets of air or water might be employed. The jets should take the form of a thin sheet, and be directed so as to strike into the descending stream of fluid cinder. The fluid cinder, thus acted upon, will be driven forward by the mechanical force of the jet, and be thereby caused to assume the form of threads as it cools in falling through the air; which threads, by intermingling, present an appearance not unlike coarse wool. By thus ensuring a very fine division of the cinder, it can be reduced to powder by subjecting it to agitation in a barrel, in contact with shot, or by any other ordinary crushing appliance, requiring little power for working the same; or by simply ramming down the blown slag in the act of packing it in casks for transport, it will be sufficiently reduced for many purposes.

The powdered slag or cinder may be used in the manufacture of bricks, artificial stone, or cements, or employed with advantage as a mineral manure; it having been found to contain soluble silicates of potash, lime, and magnesia, with alumina, oxide of iron, manganese, and sulphur. The patentee remarks, that he also proposes to utilize old cinder or slag by remelting it, and treating it in the manner above described.

Ordinary steam is used for effecting the mechanical disintegration, or breaking up of the slag, as it may be readily obtained from the blast engine boiler, and a pressure of from 10 to 12 lbs. is found sufficient for the purpose. The pressure may, however, be regulated by a cock. The form of jet most convenient resembles that well known as the "bat-wing" burner, used in gas burning, the slit being $\frac{1}{16}$ of an inch wide, by 2 to 3 inches long, according to the quantity of slag flowing from the blast furnace. The size of jet and pressure required, however, to produce the best effect, is soon found by a little practice. The steam may be conveyed to the descending stream of slag through an arrangement of ordinary gas pipes, with joints and elbows, turning so that the orifice shall come a couple of inches behind the stream of slag. The steam may be allowed to escape from a slit cut in the pipe itself, or a row of small jets of a circular or oval form may be used. When the jets and the pressure are properly adjusted, the "blown" slag will, in great part, be reduced to a fibrous state, resembling coarse wool, and it will, therefore, be liable to be carried away by any passing current of air. To prevent this, and more especially when jets of air are used to effect the reduction of the slag, it becomes necessary to form a chamber in front of the blast furnace, to receive the fibrous material. This chamber should be of a taper form, and may, from time to time, be emptied by a cradle, as is commonly done in discharging coke ovens, or in any other convenient manner.

The less reduced particles of the blown slag assume the form of shot. When the reduced slag is intended for use as a manure for top dressings, it is evident it must be brought to a powder, but otherwise the blown slag may be dug or ploughed into the soil with little preparation.

The patentee claims, "the disintegrating or breaking up of blast furnace slag or cinder, by subjecting it, while in a fluid state, to jets of steam, air, or water, in the manner above described."

To EDWARD JOSEPH WILLIAM PARNACOTT, *of Douro-street, Fairfield-road, Bow, for improvements in the manufacture of wheels or tools for grinding and polishing surfaces.*—[Dated 27th April, 1861.]

THIS invention relates to a novel mode of preparing grinding and polishing wheels, composed of emery or other grit, and a binding material; whereby their efficiency and durability will be greatly increased.

In making a grinding or cutting wheel, a compound is prepared by mixing together ground emery, stone, grit, and pounded clinker, or other suitable cutting substance, with gold size and litharge, or white lead, which serve to bind the grit and harden the compound; and to this mixture, while in a plastic state, is added a portion of lamp black or ivory black, which serves to color the product and to separate somewhat the granules of cutting substance employed. The proportions of these materials may vary, but the following produce a good result:—take of fine emery, 2 lbs. 8 oz.; stone grit, obtained from the stone-mason's yard, 1 lb. 8 oz.; clinker dust, 8 oz; lamp black or ivory black, 8 oz.; gold size, 2 oz.; and litharge, 3 oz. This compound, when thoroughly combined, is submitted to great pressure in a metallic mould, suitably shaped to produce a wheel of the required shape and size. For moulding a wheel of the form of a square-edged disc, for example, a divided ring, having lugs, is provided to receive screw bolts, for holding the parts together and permitting of the ring being opened when required. The inner diameter of this ring is turned to correspond to the diameter of wheel required to be moulded, and to the under side of the ring is applied a plate, the two being secured together by screw bolts. This plate, which forms the bottom of the mould, is provided with a central stud or core, for moulding a central hole in the wheel, to receive the wheel spindle. The mould is placed on the plunger of the hydraulic press, and immediately below a fixed block, which is intended to enter the mould and impart the pressure to the compound. Before placing the compound in the mould, a disc of tin is dropped therein, and this is covered with a disc of wet brown paper; the sides of the mould are next dusted over with powdered black lead, to prevent adhesion; a measured quantity of the compound—sufficient say to produce a wheel of half an inch in thickness—is then inserted in the mould. Over this is laid a disc of wet brown paper, of the diameter of the mould, and above the paper is placed a loose disc of tin of the same diameter, and hydraulic pressure is then applied. On removing the mould from the press, the metal discs will come out with the moulded wheel, and thus ensure its easy delivery.

The pressure found sufficient for a wheel of 6 inches diameter is about 70 tons, a proportionate increased pressure being required for larger surfaces. Wheels thus produced are to be subjected to a heat of from 300° to 400° Fahr., in any suitable construction of drying stove,

for about two hours, by which means the ageing or drying of the wheels is expedited.

To produce what is termed a "soft wheel," suitable for sharpening saws (for which operation a wheel is required that will not jar against the saw teeth), it is preferred to use, in place of the gold size, a vegetable gum, known as valata in the market. In this case, the use of litharge or white lead is omitted; and although the consolidation of the wheel is effected, as in the former instance, by pressure in an iron mould, a slight pressure by comparison is employed; that is to say, to a wheel of 12 inches in diameter and ⅞ of an inch thick, a pressure of about 15 tons only is applied. The proportions of the above-named materials which have been found to give a good result are—fine emery, 1 lb., stone grit or masons' dust, 2 lbs., clinker dust, 4 ozs., lamp black or ivory black, 1 oz., and valata, 4 ozs. The heat of the drying stove to which the soft wheels are to be subject, will be in general about 350° Fahr.

To prepare a buffing or polishing wheel, the finest kind of emery is used, with fine Bilston grit and clinker dust combined with gold size, in about the proportion or rather less than that stated above; lamp black or ivory black and litharge being used as before; or in lieu of litharge, burnt copperas. This compound, when well mixed, is moulded as before explained, it being submitted to about the pressure above mentioned for the "soft wheel" in iron moulds, in order to obtain the required consolidation of the compound.

The patentee claims, "the process or processes above described for manufacturing grinding and polishing tools."

To JOSEPH STRANGMAN RICHARDSON, *of Waterford, Ireland, for improvements in preparing the carcases of pigs and other animals for curing.*—[Dated 7th April, 1864.]

IN preparing the carcases of pigs and other animals for curing, it is important that they should after death be cooled, and their surfaces dried as speedily as possible.

Now this invention consists in subjecting the carcases of pigs and other animals to streams of atmospheric air artificially produced, in order to cool and set the flesh, and to carry off the natural moisture from the surfaces. For these purposes an enclosed building or chamber is used, having a perforated floor, or perforated pipes, to permit streams of fresh air to be forced into the room by a fan or other blowing apparatus. Openings are also formed at the upper or other parts of the building or chamber, to admit of the free passage away of the atmosphere from the chamber, as fresh streams of air are forced into it by the fan or other blowing apparatus. Or, in place of forcing the fresh atmospheric air into the chamber, a like effect may be produced by withdrawing the air therefrom by means of a fan or other apparatus—the outer air being permitted to pass into the chamber by numerous perforations or small passages through the floor or other parts thereof, or through perforated pipes or other conduits. The fresh atmospheric air, thus applied through numerous small passages, may be

taken direct from the outer atmosphere, or it may be cooled by the use of ice or other means. One method of cooling the air to be forced or drawn through such building, is to cause the air to pass through tubes surrounded by cold pickle, or it may be ice; or the air may be deprived of its moisture by being passed through or over the surface of lime or other material having an affinity for moisture, and in some cases may be dried by being heated, particularly when there is much damp in the atmosphere. Gases of an antiseptic character, such as sulphurous acid gas, or nitrous acid gas, may be employed in addition to the supply of atmospheric air for cooling, and for the purpose of preventing decomposition. As soon as the animals are killed, the carcases are suspended in the chamber, and subjected to the action of a quickly changing atmosphere, till the flesh is cooled and set, and the surfaces dried.

To DAVID MOSELEY, *of Ardwick, Manchester, for improvements in the manufacture of cloths composed of woven or felted fabrics or fibrous substances combined with india-rubber, gutta-percha, or balata, or any of their compounds.*—[Dated 8th April, 1864.]

THIS invention relates to the inlaying or tessellating of cloth in a variety of colors and patterns, so as to render it suitable for floorcloths, table mats, and for various other uses.

The mode of operation is as follows:—A piece of woven or felted cloth of woollen, cotton, flax, or other fibrous substance, is coated with india-rubber, gutta-percha, or balata, or their compounds, by means of rollers, or by spreading, in a state of solution, the india-rubber, gutta-percha, or balata, or their compounds, colored with vermillion, indigo, chrome, metallic oxides, or any other coloring matters. The prepared cloth is then cut, by means of a knife, or by a screw press or otherwise, into different shapes and forms, such as octagons, hexagons, circles, or any other patterns or designs. The pieces or patterns so cut are then placed upon a piece of linen or other cloth made adhesive by means of india-rubber, glue, or any suitable gelatinous or glutinous substance, so as to form different patterns or designs in imitation of tiled floors. After a sufficient number of pieces or patterns have been put together to make the length and width required, the whole is passed between rollers, so as to make the joints perfectly even and good. In order to render the tessellated cloth unaffected by heat or cold, it is vulcanized either by steam or water in the manner known as "Hancock's" process, or by saturating it with a solution of bisulphuret of carbon and chloride of sulphur, in the manner known as "Parkes's" process, but it is sometimes found advantageous to leave it in its unvulcanized state.

Instead of coating the cloth with pure or unadulterated india-rubber, it may be mixed by means of a masticator, or by rollers, with cotton, woollen, flax, hair, or other fibres, minerals, metallic oxides, cork, or other substances, according to the purpose for which the cloth is to be applied. When great substance or strength is

required, more than two thicknesses of cloth are combined together as above described. In some cases no cloth is requisite, but the india-rubber, gutta-percha, or balata, or their compounds, are combined with fibrous substances alone. Or the surface of the cloth may be printed in imitation of the tessellated cloth by the ordinary block printing process, or by rollers; and a solution of india-rubber or of oil or other varnish being used to print in different patterns and colors upon the cloth covered with caoutchouc, gutta-percha, and balata, or other compounds.

The patentee claims, "the manufacture of compound cloth composed of woven or felted fabric or fibrous substances as a ground or foundation, and ornamented in imitation of inlaid or tessellated work, by the application thereto of various patterns and designs in detached pieces, or by printing, as described."

To BENOIT XAVIER RICHARD *and* RAYMOND RADISSON, *of Lyons, France, for improvements in the manufacture of gold and silver wire.*—[Dated 9th April, 1864.]

IN manufacturing gold and silver wire according to this invention, the metal is cast into an ingot, which is pierced through the centre of its length with a hole, into which is run refined copper or other suitable metal. Afterwards, when the solidification is complete, this compound ingot is rolled or drawn down until it is reduced to the dimensions required for the wire to be produced,—the wire being subjected to the annealing and other operations of wire drawing. The copper in the interior of the ingot is drawn down, together with the exterior metal,—the two metals forming but one and the same body. The interior metal may be introduced into the ingot in any other suitable manner, as, for example, by electrotype processes, or by introducing mechanically, or by the aid of solder, a metallic core into the ingot, or by casting silver or gold around an interior core. The shape to which the ingot is cast should be such that the ingot may readily be adjusted in a lathe or boring machine, in order to have a hole bored longitudinally through it. For this purpose an ingot square in section is preferred. The ingot should be made about 14 inches long by 2½ inches square. A central hole is drilled longitudinally through it, the size depending upon the relative proportions it is desired the core should bear to the exterior coating of silver or gold. In order that the interior of the hole may be perfectly clean and free from grease, the interior is washed with a weak solution of potash or soda. The ingot is afterwards freely washed with water, and is then heated to about 550° or 650° Fahr. The melted copper or other metal, or alloy, with which the centre of the ingot is to be filled, is then, when well hot, poured into the centre of the ingot. The ingot is then hammered whilst in a heated state, so as to draw it down to a cylindrical form, about 1½ inch in diameter. One of the ends of the ingot is also drawn down into a point, in order that it may pass through the holes of a draw plate to be taken hold of by the pincers, which are to draw the rest of the ingot through the

holes. After the ingot has been drawn down five or six times, the ingot is annealed, and afterwards drawn down to the size required, ordinarily without being again annealed; this, however, will depend upon the purity of the metals employed.

To JOSEPH LILLIE, *of Manchester, for improvements in cocks or taps for measuring fixed quantities of liquids, and for registering or indicating the same.*—[Dated 12th April, 1864.]

THE improved taps or cocks are intended chiefly for drawing off and measuring spirituous liquors, in certain fixed quantities; for instance, such as are customary in the retailing of spirits, and for counting, indicating, and registering the number of measures thus drawn.

In carrying out the invention, the plug of the tap is made hollow, and closed at the top and bottom, thus forming a cylindrical chamber of a capacity corresponding with the desired measure. The body of the tap surrounding the plug has on one side a narrow vertical slot, opening into a short pipe cast to the tap, and which forms the connection with the supply pipe, whilst a second similar slot, which may be opposite to the supply pipe, opens into the spout. The plug has two similar slots, forming the inlet and the outlet of the chamber or measure; and they are so disposed, that whilst the inlet communicates with the supply pipe, the outlet is closed, and the chamber or measure is filled with the liquid. By turning the plug to the extent of the width of a slot, the inlet will be closed as well as the outlet; and by further turning the plug till the outlet opens into the slot communicating with the spout, the liquid will flow off. The relative position of the inlet and the outlet is such, that by giving the plug a turn of one-tenth of a revolution in one direction, the inlet shall be open; and by giving a turn of one-tenth of a revolution in the opposite direction, the outlet shall be open.

The vent hole, for the escape and admission of air during the filling and emptying of the measure, is formed in the roof of the plug or measure, and the roof is made conical, and rises from the circumference towards the centre, to facilitate the escape of the air, when the measure is nearly full of liquid, to the top of the cone, in which the vent hole is formed. A valve or stop, actuated by a float, closes or opens the vent hole, as the measure is filled or discharged. In the centre of the measure a cylindrical stud is fixed to the plug bottom, and serves as a guide to the spindle or float valve. This stud also serves for holding one, two, or more cylinders or discs, of china, which are provided with a hole in the centre to fit the stud. The object of these discs is, to vary the capacity of the measure in accordance with the cubical contents, so that the same plug can be used for various measures. The handle or the plug is connected with a suitable registering apparatus, in such a manner that every measure filled and discharged is marked and registered by the same. The body of the tap is made to project above the plug, so as to form a cylindrical box, into which the indicator is fitted, and which can be closed by a lid, and locked if desired. The taps may be constructed so that the plug can be fixed to a bracket, and

the body of the tap made to turn round the same,—a flexible tube, in this case, forming the connection with the supply pipe. The spout may at the same time serve as a handle. In order to facilitate the off-flow of the liquid from the tap, the bottom of the measure is made slanting, in preference at an angle of 45°. Several taps, of different capacities, may also be constructed, fitted one above the other. The indicators may be fitted each over its corresponding tap, and marked with the necessary divisions, letters, and figures on the periphery of a wheel or disc, but the several indicators are preferred to be placed one above the other on the top of the whole apparatus; and for this purpose, the plug of the lowest tap is formed with an arbour passing through hollow arbours of the taps above. Thus, if there are four taps, the arbour of the bottom tap passes through the hollow bosses and arbours of the three taps above it; the arbour of the next tap passes through the hollow arbours of the two taps above it; and so with the next—the arbour of each plug being connected with its corresponding indicator. The body of the several taps is cast in one piece. The several inlet slots are connected with a passage, communicating with the supply pipe; and a like passage connects the outlet slots and forms the spout; but, in all cases, each plug or measure works independently of the others. In order to ensure a proper action of the valve in the vent hole, and to prevent its sticking fast in its seating, the valve is depressed every time the plug is turned for discharging the measure. This may be effected by means of a projection or inclined plane attached to the top of the plug or to the handle, being brought to bear on the top of the valve at the desired moment; or it may be effected by means of a spring attached to the body of the tap, which being raised and again liberated by an inclined plane, will strike or press upon the valve. The plugs, which are made slightly conical, are held in the taps by means of a stud, formed at the bottom of the plug, which passes through a plate placed across the bottom of the tap, against which it is secured by means of a nut or pin packed by an india-rubber washer, or by a spiral or other spring.

The patentee claims, "Firstly,—the combination of measuring tap or cock, as described, with a counter or registering apparatus. Secondly,—the use of loose cylinders or discs, for the purpose of varying the capacity of the measure, as described. Thirdly,—the making the bottom, in the inside of the measure or plug, slanting towards the outlet slot, in the manner and for the purpose as described. Fourthly,—the making the roof of the measure or plug conical, in the manner and for the purpose as described. Fifthly,—the making the plug a fixture, whilst the body or casing of the tap revolves, in the manner described. Sixthly, and lastly,—the construction and use of the compound tap, composed of several plugs or measures of different capacities, and working independently of each other, in one outer casing, in the manner and for the purpose as described."

To WILLIAM EDWARD NEWTON, *of Chancery-lane, for improvements in the treatment of the low or poor products obtained in the manufacture or refining of sugar,—being a communication.*—[Dated 30th May, 1864.]

IT has long been the practice in sugar works and refineries to employ what is called baking in the grain; that is to say, that by this process the crystallization of the sugar and evaporation are effected simultaneously; but this method of baking can only be applied to matters somewhat rich in sugar.

The crystallization of the low or poor matters, instead of being effected during the baking, is produced afterwards by leaving them to themselves, during a long space of time, in vessels of a capacity increasing in proportion as the matter is poor, and in localities which are kept at a high temperature. This necessitates a large number of vessels and a large space, together with sufficient heating appliances, also much time (say several weeks), during which the substance must become deteriorated. Besides this, the crystals formed are very small, and difficult to separate from their syrup of crystallization. These syrups are therefore very rich, and require several bakings and crystallizations before arriving at the extraction of the last products.

The object of the present invention is to extract at once and very quickly all the product obtainable from the low or poor matters, and at the same time to produce crystallization during the baking.

To this end a part of the low or poor matter is baked, by the ordinary process, in a sugar pan, either in a vacuum or not. This baked product, if left to itself, will, at the expiration of some time, become crystallized. When crystallization commences, the baking is continued in a vacuum pan, and conducted in such a manner that during the process of evaporation the crystals already formed are fed with successive supplies of syrup or clarified sugar of the same nature.

The commencement of crystallization, above mentioned, may be effected in the apparatus which has served for the first baking, or, by preference, in a separate vessel. In any case, the second stage of the operation, which consists in feeding the crystals, must be conducted in a vacuum or in apparatus open to the air, and at a low temperature.

This improved process, which participates in the two processes of crystallization now in use, therefore consists in charging a vacuum apparatus with matter which has been previously partially crystallized as above mentioned, or even with matter prepared with powdered sugar, or matters completely crystallized and diluted with syrups, clarified or not, or water; and, the apparatus having been charged, the working is by feeding the crystals successively with clarified or other syrup.

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

November 22, 1864.

J. R. McCLEAN, Esq., President, in the Chair.

Previous to resuming the discussion upon Mr. Mann's paper "*On the decay of materials in tropical climates*," a brief communication, on the same subject, by Mr. William J. W. Heath, Assoc. Inst. C. E., was read.

During a residence in Ceylon, extending over a period of seven years, while engaged on the railway, Mr. Heath's attention had been directed to those materials which were most used in the construction of permanent buildings. The habitations of the lower class of natives were formed of a rude framework of stout bamboos, the sides and roof consisting of reeds, closed in with the interwoven leaves of the cocoa-nut palm, the latter being washed over with the slimy juice of a native fruit, which, when dry, resembled copal varnish. In the huts built of "wattle and dab," the framework was made of roughly-squared jungle trees, the space between being filled, and both the inside and the outside of the hut being covered with clay and sand well kneaded, afterwards plastered over with earth thrown up by the white ants, mixed with a powerful binding substance produced by the ants. Superior houses were built of "cabook," a soft kind of rock, found at a few feet below the surface: this material had the appearance of a coarse sponge, the interstices being filled with soft clay. Before being used, the blocks should be exposed to the rain, to allow some of the clay to be washed out. Cabook required to be protected from the weather, but if covered with a thin coating of lime plaster, it would last for years. Hard kinds of stone were not much used, owing to the expense of working them; and rubble masonry was not approved, as there was difficulty in obtaining even beds and good bond. Bricks as a rule were so badly burnt, and the clay was so badly pugged, that brickwork in exposed situations, and unprotected, would perish very rapidly. It was advisable that it should in all cases be well plastered with lime water. Two or three coats of boiled linseed oil would preserve brickwork without hiding it, but the expense prevented its general use. Coal tar was an excellent preservative, but on account of its unsightly appearance it could not often be employed. Lime was generally made by calcining white coral. When taken from the kiln it was in a fine white powder, fit for immediate use, after being mixed with twice its own bulk of sand and water. It set so rapidly, that, in the Public Works Department, it was the practice to keep the lime under water for two days before using it. This had the effect of making it longer in setting, but it was more easily worked, and eventually made better work, equal, in fact, to the best blue lias lime. Well-seasoned timber, with free ventilation, would endure for many years, if the white ants were kept away, without any precautions being taken to preserve it. In exposed situations, and

where subject to the attacks of the white ant, Stockholm tar was the best preservative; while creosoted timber was free from their ravages. In sea-water, and even in fresh-water lakes and canals, timber was speedily attacked by worms, notwithstanding that it might be painted, oiled, or tarred.

Iron exposed to the influence of the varying weather speedily oxidised, but oil, applied hot, was a good preventive. Coal tar was, however, the best covering, applied either cold or hot, or before or after oxidation had commenced. Ordinary galvanized sheet iron did not last many years, unless protected with good red lead paint, frequently renewed; but zinc would last for many years, with little or no decay.

In the course of the discussion it was stated that, on the Great Indian Peninsula Railway, Baltic sleepers, both creosoted and Kyanized, and native jungle wood sleepers, had been used; but after thirteen years' experience, those which had failed were being replaced with teak and iron sleepers. The native woods were so hard and close grained, that they could not be impregnated with any preservative substance. The keys were a source of great trouble in warm and variable climates. Those of wood had not been found efficient in India, and endeavours were now being made to devise a substitute. Ironwork of all kinds should be thoroughly cleansed, dried by heat, and then dipped in hot linseed oil, before being exported from this country.

It was contended that it was impossible to predicate what timber would sustain, for while yellow pine had been known to last sound, as railway sleepers, for twenty-five years, in other cases it had decayed in five or six years. This frequently happened also with hard tropical woods, without there being any apparently assignable cause for this difference in the rate of decay. Hence, in the tropics, iron was nearly the only material that could be employed, especially for sleepers, with anything like certainty as to the results. No doubt iron made a rigid permanent way, unsuitable for the high speeds common in this country, although possibly this might be partially obviated by a more perfect manner of securing the rails on the sleepers; but in tropical climates the use of iron was almost a necessity, and there a speed of from 25 to 30 miles per hour was a maximum. Greaves's cast-iron bowl sleepers had been laid for eighteen years on the Egyptian railway, and made a good and substantial road. The objection that they were liable to break, particularly along the centre line, might be met by making them stronger; and it was remarked that on the Dom Pedro Segundo Railway, Rio Janeiro, the bowl sleepers had been in use for eleven years, and only one sleeper per mile had required to be renewed.

On the East Indian line, of more than 1000 miles in length, the sleepers were principally of sâl timber, but there were others of creosoted fir and of iron. Although there were many different kinds of suitable native woods, there was difficulty in obtaining large quantities of any other than sâl, which, when cut out of large timber and well seasoned, was very durable. Recently, in opening a part of the line near Calcutta, sâl sleepers had been found in a good state of preservation after having been laid twelve years. In other parts of the line,

creosoted sleepers were in a serviceable condition after being in use ten years. Teak was, perhaps, the best of all Indian woods, but the cost precluded its use for sleepers, as it would amount to 15s. per sleeper. Flat iron sleepers had been unsuccessful, but cast-iron bowl sleepers seemed to promise better results, although at present they had not been sufficiently long in use to enable a definite opinion to be pronounced. The breakage, so far, had been serious, amounting to about 20 per cent., but this might be obviated in future by making them stronger, as had been suggested. The use of iron was desirable, on account of the difficulty of obtaining large supplies of timber sleepers, and the uncertainty as to their quality.

Although the decay of materials in Ceylon was unquestionably influenced by the alternating effects of heat and moisture, yet it was believed to be principally due to the use of inferior materials. In the upper districts of India, there were brick and stone buildings of great antiquity, in fact anterior to historic periods. Sâl timber was hard, durable, and abundant in the central forests, and along the base of the Himalayas, and had been generally employed by the Public Works Department; but owing to the great demand of late years, it was now hardly possible to obtain it well seasoned. Teak was also becoming scarce: that which grew in the province of Burmah was of large size and very useful for shipbuilding; while, when cultivated, in a drier range and upon rocky ground, it was as hard as ebony, or iron wood, though of small scantling and of crooked form.

It was noticed as remarkable, that the observations in one Paper were repeated in the other, and that the means of preservation which had been suggested as applicable in Brazil, were likewise recommended for Ceylon. There were, however, some points of difference—especially as to the use of galvanized iron. The author of the first communication, speaking apparently from opinion rather than from experience, advised its use, while the author of the second, on the contrary, thought that galvanizing alone, without painting or tarring, was not adequate to protect iron in such climates. As corroborative of the remark, that the loss of weight in iron from oxidation was less in Ceylon than in England, in an equal period of time, it was mentioned that out of a quantity of rails, which had been manufactured at the same time and at the same place, some were lying for many months unused at Ceylon, and others in South Wales, when the loss of weight by rust was found to be largely in excess at the latter place. Where there was great heat, combined with excessive moisture, it was imagined that the effect upon materials, particularly timber, could not be otherwise than serious. While, in the first instance, it might be prudent to import timber artificially prepared, owing to the absence of available data as to the character of the native materials, yet it was believed, as the qualities of the different kinds of native woods became better known, as well as the proper time to fell them, and to prepare them by shed-drying, or otherwise, and as a more ready access was obtained to the forests, native woods might ultimately be used with advantage and economy. In fact, a specimen of native Brazilian wood had been exhibited, which had endured for 250 years. The alleged excessive wear of the rails and tires in Pernambuco must be explained upon other grounds than the heat. Perhaps the fact that the rails were not 'fished' until after

a portion of the line had been opened for traffic, that there were considerable curves on the line, and that the road was not laid in that perfect manner which was possible in this country, added to the great atmospheric alternations, might be sufficient to account for it.

It was remarked, that in using unprepared wood, no doubt it was desirable to select that part which was hard, as the pores being filled with ligneous matter, such timber did not so freely absorb moisture. But for creosoting purposes the reverse was the case, for it was impossible to make heart wood absorb 10 lbs. of oil per cubic foot, as was sometimes required. The great value of creosoting was, that it enabled young wood to be used, as then, the pores being filled with a bituminous asphaltic mastic, the wood so treated was perfectly waterproof, and harder than heart wood. The reason why the half-round sleepers on the Pernambuco line were more durable than those of square form, was believed to be due to all the young wood being retained in the former. Recent experiments in the harbour of Ostend showed, that wood prepared with corrosive sublimate, or with sulphate of zinc, or copper, was only partially protected against the worm, but when creosoted, the worm would not touch it. It was advisable that piles in sea water should not be squared, but used round, with as much young wood as possible.

Respecting the ravages of the white ant, there were many old structures in Brazil not so affected; and as regarded railway sleepers, the frequent shaking and vibration would, it was considered, render them tolerably safe. In that country porous and opened-grained timber seemed most subject to these attacks; but in Australia, the hardest kinds were first attacked. This was especially the case with iron-bark timber, the density of which was so great as to cause it to sink in water; and in tenacity and resistance to strain, it approached rough cast iron. White ants were effectually destroyed by oil of creosote, and anything of a bitter taste injected into the fibre, or even a small quantity of turpentine, would prevent their attacks. In some parts of India white ants were very destructive, and 10 per cent. of some stacks of sleepers had been decayed at the heart in from six to eight months. The black ants of the West Indies were also more destructive in hard than in soft wood. Some descriptions of wood there were neither effected by the teredo navalis, nor by the black ant, and when used for piles had never been known to decay.

With regard to stone, it had been found that the application of linseed oil not only acted as a preservative, but it rendered soft stone in the course of a short time very hard. In Jamaica, the bricks were well made, and of good materials; and some buildings there had stood from time immemorial, without exhibiting any signs of decay. Mortar, both there and at the Cape, was made of shell lime, and even when mixed with sea sand it was hard and durable. In India, the addition to the lime of about five per cent. of jaggery, a coarse native sugar, caused the mortar to set well, and to be very durable. At the Cape the bricks were not good, and owing to the exudation of phosphate of soda after the work was finished, it was advisable to plaster all brickwork. In India, the telegraph posts were, to a large extent, of stone obtained from Agra, and the rapid decay of timber, when used for that purpose, had greatly retarded telegraphic extension in that

country. The difficulty was now being met, by making the lower part of the posts of iron, into which wooden posts were inserted.

Respecting the statement, that the only examples of iron bridges in the province of Pernambuco were those belonging to the railway, and that of St. Isabel, completed in 1863, it was remarked that, about twenty years ago, a French engineer, M. Vauthier, when Engineer-in-chief to the Province, designed and erected a suspension bridge on one of the main roads, about nine miles from the city, across the river Capibaribe, at the village of Caxangá. The roadway, which was 100 feet long by 20 feet wide, was suspended from a pair of iron wire ropes on each side of the bridge, by vertical rods of wrought iron, the attachment of the rods to the ropes being by means of strong wrought-iron plates embracing both ropes. Each rope was in four separate pieces, and consisted of a mass of wires simply laid together, and bound at intervals. The rocking standards were of cast iron, in three pieces, and the platform was of wood. All the work was executed in the country, including the casting of the standards, but the wire was purchased in England. The ropes, as well as the cast and wrought-iron work, were still sound. The cost had amounted to between £5000 and £6000.

November 29th, 1864.

The paper read was, "*Description of the Great Grimsby (Royal) Docks; with a detailed account of the enclosed land, entrance locks, dock walls, &c.*," by Mr. E. H. Clark.

The author stated that the old dock, formed from a natural creek, measuring in extent about 19 acres, was comparatively useless, by its shallowness, and by the narrowness of the entrance channel. When the means of carrying out an extensive water commerce at the port of Grimsby were contemplated, the Manchester, Sheffield, and Lincolnshire Railway Company, who had become the proprietors of the old haven and dock, presented an extensive project to Parliament, designed by the late Mr. J. M. Rendel, which was sanctioned in the year 1845, and had since been completed. It comprised the formation of an entirely new dock, the entrances of which lay beyond the limits of low water; the new works being advanced into the River Humber, for a distance of three-quarters of a mile, and embracing an enclosure of 138 acres of land reclaimed from the river. The works of this enclosure were commenced in the spring of 1846. They comprehended the construction of wharves, embankments, and a cofferdam, together nearly 1½ mile in length. The cofferdam was remarkable for its magnitude, exposed position, and independent stability. Considerable difficulties were encountered in several places in obtaining a firm foundation for the wharves and embankments; but these were successfully overcome through the exertions of the late Mr. Adam Smith, the resident engineer, principally by loading the soft ground with chalk stone. The enclosure was completed by the end of the year 1848, when the interior works were commenced. These comprised the construction of a dock of 25 acres, with a depth of 6 feet at low water, and of 25 feet 6 inches

at high water, ordinary spring tides; of two entrance locks to the dock, the larger one being 300 feet in length between the pen gates, and 70 feet in width, and the smaller one 200 feet in length by 45 feet in width; and of a tidal basin of 13 acres, enclosed by timber piers, with an entrance 260 feet in width. There were also extensive timber ponds, a graving dock, with a width of entrance of 70 feet, and on the quays, which were 3600 feet in length, transit sheds and bonding warehouses, granaries and cotton sheds, cattle pens and coal spouts, with a railway passenger station, and branch railways through the warehouses, besides a small dock, for fishing craft, 6 acres in extent, and having an entrance 20 feet in width, with the usual appurtenances connected with that trade.

The contractors for the cofferdam were Messrs. Linn, of Liverpool, and, for the dock works, Messrs. Hutchings, Brown, and Wright.

The cofferdam was 1500 feet in length, and consisted of two circular arcs, with a straight return on the west side,—the versed sine of the curved portion being one-fifth of the span. It was situated where the average velocity of the tide in the River Humber was 5 miles per hour, and the rise of tide was 25 feet. There were three parallel rows of whole timber sheet piles, of Memel fir, averaging 60 feet, 47 feet, and 37 feet in length, respectively. The piles were driven in bays of 10 feet, and there was a space of 7 feet between the outer and the middle rows, and of 6 feet between the middle and inner rows. Clay puddle was filled in between the rows. The tie bolts, connecting the rows of piles, were arranged so as to break joint, to prevent a run of water directly through the dam. The chief novelty was, however, in the counterforts or supports, placed at intervals of 25 feet along the whole length of the dam, and extending for 18 feet in depth, so as virtually to give the cofferdam a base of 32 feet in width. The counterforts were composed of whole timber sheet piles, and were firmly attached to the dam by wales and struts. The total quantity of timber used in the dam amounted to 709,000 cubic feet, and its construction occupied two years and a-half.

The wharf extended from the old dock entrance to the west end of the cofferdam, a length of 2431 feet, and from the east end of the cofferdam eastward for a length of 1208 feet, where it was joined by an embankment 1800 feet in length. The wharf was constructed of a single row of whole timber sheet piles, with a dry rubble wall of chalk stone at the back, in the centre of which there was a puddle wall.

The embankment was composed of the stiff clay thrown up from the foreshore, and was faced with chalk stone on the seaward side, which had a slope of 5 to 1, while on the inland side the slope was 2 to 1.

The two entrance locks were separated by a pier of masonry 70 feet in width. Each lock was provided with two pairs of pen gates, and one pair of flood gates. The ground over the whole area of the locks, centre pier, and wing walls, was excavated to a depth of 8 feet below the cill of the larger lock, and bearing piles were driven in rows, 5 feet apart from centre to centre, and in some places 4 feet apart from centre to centre, over this area. A pile was considered to be sufficiently driven when it did not move more than one quarter of an inch with a blow of a ram weighing 1 ton, and falling through 12 feet. The heads of the piles were then cut to a uniform level, the ground was removed to a

depth of 2 feet below this level, and this space was filled up with concrete. Whole timbers, so connected as to form continuous ties across the locks and centre pier, were then laid transversely, in parallel rows, on the bearing piles. Other similar timbers were laid at right angles to the transverse bearers, concrete being filled into the upper surface of these longitudinal bearers, which were then covered with planking, to serve as a bed for the masonry. Upwards of 254,000 cubic feet of timber, in addition to the sheet piles, were thus employed.

The masonry of the pointing cells, gate tables, inverts, aprons, platforms, square quoins, and culverts, was of Bramley Fall stone; the hollow quoins were of stone from the Calverley Wood quarries; while the backing to the walls was of chalk stone, hammer dressed, laid in regular courses, and well bonded with ashlar. The inverts and platforms for the gates were wholly of stone; the cills were straight, and the joints of the masonry radiated horizontally and vertically, corresponding to the radius of the inverts. There were three main culverts—one in the centre pier, and one in each wall of the larger and smaller locks, communicating with the dock, with branches and outlets to these culverts, for filling and emptying the locks, for scouring the entrance channel, and for clearing the gate tables.

From the treacherous nature of the ground on the site of the proposed dock walls, and from the necessity of obtaining good foundations for the granaries and transit sheds, Mr. Rendel decided to form the walls of piers, varying from 40 to 80 feet in length, and generally about 6 feet thick, built of chalk rubble masonry, faced with ashlar, the space between the piers being arched over with brickwork. The backing of the walls consisted of a slope from the back part of the arch to the dock bottom, with a batter of 2½ to 1, composed of puddled clay, faced with rough chalk stone.

Blue lias lime, from Lyme Regis, was used in the preparation of the mortar. It cost, delivered at Grimsby, 10*s*. 6*d*. per ton. The mortar was of two kinds; the proportions of that employed for pointing and facework were, ten parts of slacked lime, eight parts of screened sand, one part of forge ashes, and one part of pozzuolana. The other, used chiefly for the backing of walls and buildings, was composed of sixteen parts of slacked lime, twenty parts of screened sand, three parts of forge ashes, and one part of pozzuolana. The cost of the former was about 16*s*., and of the latter about 12*s*. per cubic yard.

The gates were of timber, chiefly of oak from the Black Forest, but teak and mahogany had been used. They were regular trussed girders, each pair of bars being trussed by wrought-iron straining rods. Each leaf of the gates for the 70 feet locks weighed about 75 tons, and when completed, in 1850, they were considered to be the largest timber lock gates ever made. It having been found on trial, when the large gates were being erected, that the ordinary roller, fixed on the outside, was out of the vertical plane passing through the centre of gravity of the gate, causing the gate, when moved, to twist considerably, it was determined to have two rollers, one on each side of the gate, but both to travel on the same path. The inner one was necessarily of smaller diameter than the outside one, and a cast-iron box was provided for the inside roller to fall into, when the gates were closed. There was a false door at the back of this box, and when any hard substance was forced

against this door, a bar at the back was broken. During the twelve years these rollers had been in use, these bars had only required to be replaced about twelve times in the three pairs of gates. The gudgeon, on which the heol posts of the gates revolved, was of solid cast iron, and the cup, which fitted into the horn of the heel post, was of the same material, but in the top of the cup there was a piece of brass of a converse shape. The pointing cills of the gates were straight, and corresponded with the bottom bars of the gates. They were protected by cast-iron face-plates, jointed and planed so as to form a perfectly water-tight joint. The cost of a pair of gates for the larger lock, 70 feet wide, was £2300, exclusive of the machinery for working them. This was the first instance of the application of Sir W. G. Armstrong's hydraulic machinery for opening and closing lock gates, and its cost for the six pairs of gates in both locks was about £4000, including foundations and cast-iron pits for the chains to work in. Two men only were required to work the gates of both locks, which could be opened in two minutes and a-half, and the machinery, which had now been in use for ten years, had required very few repairs, and had answered admirably.

The piers forming the boundaries of the tidal basin were of open timber work, constructed in bays of piles in clusters, each bay being 25 feet apart. The whole of the timber had been thoroughly creosoted, at the rate of 45 gallons of oil per load of timber. The channel, from the mouth of the basin to the entrance locks, averaged 260 feet in width, and was kept to the level of the lock cills by frequent scouring and by occasional dredging. Immediately outside the tidal piers the channel was 3 feet below the level of the larger lock cills, and the scour of the tides past the pier heads had gradually deepened the channel, since the construction of the dock works, from 3 feet to 4 feet. In addition to the means provided for sluicing the silty deposit from the channel of the tidal basin, the back water from the country, which originally flowed into the old dock channel, was now diverted into the tidal basin.

A graving dock had been constructed since the opening of the new docks, with a width of entrance of 70 feet, the cill being laid at the level of 6 feet above the cill of the larger lock, giving an average depth of water of 19 feet 6 inches. The length of the dock for keel was 350 feet, the width of the floor was 52 feet, and at the level of the coping 96 feet, tapering to 84 feet at the ends. The area of the dock was surrounded by a row of Memel fir sheet piles; and rows of piles were driven in the centre line of the dock, to support the weight of the ships when blocked. The ground within this area was removed to a depth of 6 feet, and was replaced by concrete. The inverts and gate tables were of Bramley Fall stone, and the joints were radiated both vertically and horizontally. The floor was curved, instead of concave or flat, as was the usual plan; thus giving greater space for the workmen, and allowing of better ventilation round the sides of the vessel. The sides of the dock were in nine steps, each step being 3 feet in height, with a width of tread of 3 feet. The graving dock was supplied with water direct from the Royal dock, and was drained to the level of low water into the tideway; but as the floor of the dock was 3 feet below the level of low water of ordinary spring tides, a depth of water

of from 3 feet to 4 feet had to be removed by pumping. This was effected by a centrifugal pump, supplied by Messrs. Simpson, fixed in a well adjoining the dock, and its cost complete, including pipes and erection, was £413. These pumps were deemed to be very suitable for the drainage of graving docks, as they were not liable to become choked, like valve pumps, from the chips and rubbish which found their way into the well. The gates were of oak timber, and were similar to those of the locks, 70 feet wide. They were, however, worked by powerful double-purchase crabs, instead of by hydraulic machinery, as being so seldom used in comparison with lock gates, it was considered that this plan would be less expensive. The total cost of the graving dock, including the engine house and well, but not the engine and pumps, was £32,000. It was designed by Mr. Adam Smith, and was constructed, under the superintendence of the author, by Mr. J. Taylor.

Two lines of railway, laid on a timber staging, ran into the dock, having coal spouts at their extremities. These spouts, or wrought-iron shoots, were fitted with hinged joints, and were capable of being raised or lowered, by winches, to the height of the deck of the vessel. There were doors in the bottoms of the coal wagons, and breakage of the coal was in a great measure prevented, by a door being fixed inside the spouts, hinged to one of its sides, and connected, by a chain, with a winch above, by which the rate of the coals entering the vessel was entirely under control. The wagons, when emptied, descended, by their own gravity, down the return line. About 400 tons of coal per day could be loaded at each spout.

A tower, having a total height of 300 feet, was erected, and in this, at a height of 200 feet, a wrought-iron tank was fixed, capable of holding 33,000 gallons, for the purpose of serving as an accumulator of water pressure, for working the machinery of the lock gates and cranes, and of supplying fresh water to the shipping. The water was forced into the tank by two pumps, each 10 inches in diameter, worked by a duplicate horizontal engine of 25 H.P. The engines, pumps, pipes, and machinery were supplied by Sir W. G. Armstrong.

In concluding the paper, the author remarked, that he had observed, for several years past, that there was a gradual wasting away of the promontory on the Yorkshire coast, opposite to Grimsby, known as the Spurn Point. On the maintenance of this Point depended, he believed, the existence of Grimsby as a port. About eight or nine years back, when the sea threatened to make a breach between the Spurn Point and the mainland, Mr. Rendel directed the attention of the Government to the matter, and the foreshore of this neck of land was then protected, by depositing on it large quantities of chalk stone. Since then nothing had been done, and it was now to be feared, unless immediate steps were taken, that a permanent breach might be made, and the channel of the River Humber be diverted from the Lincolnshire coast, and form for itself a new outlet into the North Sea, when the channel opposite the Grimsby Docks would probably be silted up.

December 6th, 1864.

JOHN FOWLER, Esq., Vice-President, in the Chair.

The paper read was, "*Description of the River Tees, and of the works upon it connected with navigation*," by Mr. Joseph Taylor, Assoc. Inst. C.E.

After describing the course of the river, from its rise in the south-eastern flank of Cross Fell, in the Goredale series of carboniferous limestones, and the geological features of the country through which it passed, the author alluded to the works above Darlington, for supplying that town, as well as Stockton-on-Tees and Middlesbro', with water. But neither at these works, nor elsewhere, so far as the author was aware, had any gaugings been taken, with sufficient accuracy to be of value. The tide flowed as far as Yarm, and the river was navigable to that town for small vessels. At Stockton-on-Tees, 7 miles further, the river assumed considerable dimensions, and vessels of from 200 to 300 tons burthen came up to its quays. Thence to Middlesbro', 5 miles, its course was very tortuous, and immediately below, after making a sudden bend to the north-east, it opened into a wide estuary, upwards of 3 miles in width from shore to shore; but of this a large area was only covered to the depth of a few inches at high water. The bar buoy was about 8 miles below Middlesbro'. The total length of the course of the Tees was between 70 and 80 miles, and its basin contained an area of about 750 square miles.

Under an Act obtained in the year 1808, a cut was made from the east side of the river near Stockton, through a neck of land, to Portrack. This channel was 220 yards in length, and it shortened the course of the river about 2½ miles, producing a scour by which the depth of water at Stockton Quay was increased from 9 feet to 11 feet. The cost of this work was upwards of £12,000. A second cut was completed in 1830, from Blue House Point to near Newport. This was 1100 yards in length, and cost about £26,000. About the same time, the construction of timber jetties or groynes, at right angles to the stream, was commenced. Their total number at present was forty-three, and they varied in length from 40 feet to upwards of 2000 feet.

Allusion was then made to the staithes for shipping coal, erected on the bank of the river at Middlesbro'; and it was stated that, owing to the shipping berths at the staithes having become filled up, a ship of the usual draught of water could with difficulty be unloaded. In 1842, therefore, a dock was constructed, and the staithes were abandoned.

Having noticed the principal works connected with the navigation, the author next referred to their effect on the channel of the river. The first cut, of 1808, appeared to have been well devised, for it contributed to the removal of a shoal lying a little higher up the river, and produced an increased depth of water of 2 feet, at Stockton Quay. The expediency of the second cut was more doubtful, as it destroyed a broad reach of the river, thus depriving the channel below of an important reservoir of tidal water. The combined effect of the timber groynes and of the two artificial channels had been to reduce the river between Stockton and Newport to a nearly uniform width, straight

and narrow, through which the ebb tide flowed with considerable velocity. As the tide was suddenly checked at the eastern extremity of the second cut, by the greater width of the channel, the tendency was for all matters held in suspension to be deposited, thus forming shoals, and filling up the bed of the river. As this was constantly recurring, the system of groynes had been continued lower down, with a view to secure deep water, and when the wider channel was reached, it became more difficult to deal with it.

The works had caused the silting-up of the north shore of Bamblet's Blight, which must have been contemplated; but they also led to the filling up of the shipping berths at Middlesbro', which could not have been intended. In 1852, the control of the river was assumed by the present Thames Conservancy Commission. For some years previous, the river below Middlesbro' had been in a very bad state, and was continually getting worse. It was evident, by letters from shipowners, as given in Mr. Bald's report to the Admiralty in 1851, and was corroborated by the personal experience of the author, that the channel changed very much every spring tide, by the operations of the jetties below Cargo Fleet, and that it ran almost dry at low water near the ninth buoy. In fact, the effect of the groynes had been to advance the foreshore to their extremities; and in many cases the width of the original channel in the Tees had been reduced one-half, by which a large body of tidal water had been excluded, reducing the velocity of the ebb tides, and diminishing the scouring force, with a corresponding result in the lower reaches of the river. In 1821, previous to the construction of any of these works, the least depth of water between Cargo Fleet and the ninth buoy anchorage was 6 feet, excepting upon the mussel scarf shoal, since removed by dredging; and which it was estimated by Mr. Bald, in his report to the Admiralty, might have been then effected for £350, while the cost of the jetties, which did not remove it, must have been considerably greater. The works in the upper part of the river had, therefore, reduced the depth in the channel below Middlesbro' 4 feet, and the deep water anchorage berths had also been considerably diminished. It was not doubted that the channel of the river between Stockton and Middlesbro' had been made more direct, and the depth more uniform, by the construction of the various works; but the author was of opinion that better results would have been obtained by a judicious system of dredging, and that the disastrous effects upon the lower reaches of the river might have been avoided. The author believed, as a general principle, that the operation of dredging, by lowering the bed of a river, and thus increasing the tidal flow, was acting in unison with the natural scouring forces; whilst contracting the channel, by jetties or groynes, shut out a corresponding amount of tidal water, and weakened the scouring force of the ebb tide.

In conclusion, it was stated that the new commissioners had principally directed their attention to dredging the channel and to forming groynes or training walls of refuse slag from the iron works, either at half-tide level or at low-water mark, in place of the old timber jetties, by which the depth of the channel had been increased to upwards of 4 feet at low water. A breakwater, also of iron slag, was now in process of construction near the mouth of the Tees, on the southern shore, extending for a distance of about 4300 yards; and it was intended to form

another pier from the north shore for a length of about 2000 yards. The ends of these two piers would curve seawards, leaving an entrance channel of 600 yards in width. It was hoped that, by the construction of these piers, a safe and sheltered harbour of refuge would be created at the mouth of the Tees. The depth on the bar at low water spring tides was about 11 feet, and at high water 27 feet, being a greater depth than existed on the bars of the Tyne, the Wear, or the Clyde.

MECHANICAL ENGINEERS' SOCIETY.

January 28th, 1864.

(Continued from page 362, Vol. XX.)

The next paper read was, "*On the improved traversing cranes at Crewe Locomotive Works*," by Mr. JOHN RAMSBOTTOM.

THE traversing cranes described in the present paper are employed in the locomotive shops of the London and North Western Railway at Crewe, where they were designed and erected by the writer. They were seen in action by the members on the occasion of their visit to the Crewe works in the excursion at the Liverpool meeting of the Institution. From the interest manifested in them on that occasion, and the numerous inquiries that have since been made respecting them, the writer thought that a description of the principle and construction of these cranes would be acceptable to the members.

There are seven of these cranes in use at the Crewe works, which have been working successfully for some time, the first having now been three years in constant work. They are driven by power applied by a light endless cord, extending throughout the entire length of the shop traversed by the crane. This cord is driven at a very high speed—nearly 60 miles an hour; in consequence of which only a very light driving pressure is required on the shifting gear of the crane. The driving cord is kept in uniform tension by the action of a constant weight, and is arranged so as to allow of the cranes working and traversing in every direction without sensibly affecting the length of the cord.

The cranes are of two classes — longitudinal overhead traversers, of which there are two pairs in the engine repairing shop, lifting loads up to 25 tons; and traversing jib cranes, of which there is one pair in the wheel shop, lifting 4 tons. The cranes are all driven by endless cords running along the top of the shops, close to the roof tie-beams. The overhead traversers are worked, in each case, by a man seated on a platform, attached to the crab and moving with it; and the jib cranes by a man standing below at the foot of the crane, and walking along with it when traversing; each man having control over all the lifting, lowering, and traversing movements, by a set of handles.

In the engine repairing shop there are two pairs of overhead traversers, working on two parallel sets of rails, each having a span of 40 feet

7 inches, and a longitudinal traverse of 270 feet. The girders forming the longitudinal rails are carried by the side walls and by columns at a height of 16 feet above the floor. The two pairs of traversers are separately worked by endless cords, each cord being carried down the side of the shop, and returning along the same side, but at 4 feet lower level. In order to communicate motion to the traverser and crab, the driving portion of the cord is carried across each traverser to the further end and back again before passing on to the main driving pulley.

The cord is returned round a tightening pulley, 4 feet diameter, at the end of the shop, carried in a horizontal sliding frame. To this frame is connected a weight, for the purpose of giving the requisite tension to the driving cord, and taking up any stretching or temporary variation of length due to change of load or weather. The tightening frame has a traverse across the end wall of the shop, giving a range of 34 feet, which takes up a variation in the length of the cord equal to twice that amount.

The traverser is constructed of two timber beams, trussed with wrought-iron bars; and the whole is carried by four flanged wheels mounted in cast-iron carriages, into which the ends of the beams are fixed.

The longitudinal driving gear consists of a double friction disc, keyed on the vertical spindle of a driving pulley in which the driving cord runs. The spindle footstep and guide are carried by a double lever, connected to a short lever on a horizontal shaft, which extends across the whole length of the traverser, and is under the control of the attendant by means of a hand lever sliding on the shaft along with the crab, whereby the friction disc is raised or lowered so as to be brought in contact with the friction pulley either at bottom or at top, according to the direction in which the traverser is required to move. The motion of the friction pulley is reduced by a worm and worm-wheel and spur gear to a pinion shaft, which is carried across the traverser from end to end, and by means of pinions drives the carrying wheels at each end of the traverser. The frictional surfaces of the driving disc are composed of rings of alder wood, cut with the fibre on end; the edges of the wood rings are bevilled, and they are secured in their places by an inner iron ring.

The pulleys for returning the driving cord from the further end of the traverser work in inclined positions, in order that the cord which has passed across the traverser may be returned at 1½ inch lower level, and at the same time in a different vertical plane. This is done in order to facilitate the lowering and lifting movements, as afterwards described; and further, in order that the two cords which are travelling in opposite directions may not rub against each other by the swagging of either of them.

The crab of the traverser consists of a pair of cast-iron frames, carrying the chain barrel, lifting and lowering, and traversing gear; the whole being carried upon four flanged wheels running on rails, bolted upon the traverser beams.

The lifting and lowering gear is put in motion when the cord is pressed into either of the grooves of a double grooved pulley, keyed to a vertical spindle by pressure pulleys. These pulleys are of cast iron, 8 inches working diameter, and are mounted on short wrought-iron studs tapped

into a radial arm, on which they are carried. When at rest, the pulleys are clear of the cord, and are, therefore, only running when work is being done. The stud bearings are necessarily short, in consequence of the small amount of clearance between the pulleys and the roof tie-beams, which at this point does not exceed $1\frac{1}{2}$ inches. The grooves in the driving pulley are of different diameters, whereby different velocities are obtained, the smaller being used for lowering and the larger for lifting; and as the two portions of the driving cord are running constantly in opposite directions, the reversing is obtained by simply pressing one or other of the cords into contact with the driving pulley, by one of the pressure pulleys, with a pressure proportionate to the work to be done. The radial arm carrying the pressure pulleys turns upon a vertical spindle, and is cast with a toothed segment, which gears into a rack at the end of a rod attached to a hand lever. This lever is under the control of the attendant, and is held in its place by a spring catch in a notched sector.

From the driving pulley the velocity of the driving cord is transmitted and reduced through a worm and worm wheel. In order to economise space, the shaft of this worm wheel is carried through the hollow shaft on which the chain barrel and its spur wheels are mounted. The number of revolutions is further reduced by a spur pinion and wheel to the shaft, on which slide two pinions of different diameters, gearing alternately into spur wheels, also of different diameters, which are keyed to the chain barrel, so as to give a greater or less purchase as required for heavy or light loads,—the ratio of difference being about 4 to 1.

The cross traversing gear is similar in principle to the lifting gear. The two grooves of the driving pulley are, however, of the same diameter in this case, the velocity of traverse being the same in both directions. This pulley is placed on the opposite side of the driving cord to the pulley of the lifting gear, so that the cord, when used for traversing, may not foul the lifting pulley. The radial arm carrying the pressure pulleys belonging to the driving pulley is in this also worked by a rack and segment from a hand lever, which is adjacent to the hand lever of the lifting and lowering motion.

The cross and longitudinal traversing movements are made at the rate of 30 feet per minute. The heavy loads are lifted at the rate of 1 foot $7\frac{1}{2}$ inches per minute, and the light loads at the rate of 6 feet 5 inches per minute.

The wheel shop contains a pair of traversing jib cranes. Each of the two jib cranes has a radius of $8\frac{1}{2}$ feet, and a traverse of 120 feet along a single rail bolted to the floor; and is guided at the top by a pair of rolled girders of an ⟼ section. The top of the crane carries a guide roller, which just fits in between the pair of girders, and serves to support the crane laterally when lifting on either side of the rail. The driving cord is carried down the shop and back again, just below the roof tie-beams. In its course it is passed round nearly half the circumference of the driving pulley of each crane, by means of the two guide pulleys; the one crane being driven by the outgoing cord, and the other by the return cord. The guide pulleys are carried by a guide bracket upon the top of the crane post, and traverse with the crane. The tightening gear is similar in its action to that already described for the overhead traverser.

The crane is constructed of a plate box-frame, forming the base, and carrying the vertical cast-iron pillar, round which the outer casing and its attached jib revolve. The driving pulley is keyed to the vertical shaft passing down the centre of the crane post; and from this shaft all the motions are taken by means of frictional gear. The lifting and lowering gear consists of a double-friction cone of cast iron, sliding on a fast key on the vertical shaft, and moved up or down, as required, to bring the lower or upper frictional surfaces into contact with a single friction cone, from which the motion is transmitted and reduced through a worm wheel and train of spur gear to the chain barrel. The whole is carried by the cast-iron bracket, bolted to the outer casing of the crane pillar, and revolving with it. The bearings for the driving shaft above and below the double friction cone are of cast iron; but the horizontal worm spindle runs in a brass bush, the end pressure, when lifting, being taken by the collar of the bush and the end step. The driving cones are raised or lowered by means of a double lever and brass clutches on each side of the boss of the lower cone. These levers are placed under the cones instead of between them, in order that any oil thrown off the collars may not affect the frictional surface. The clutch levers are connected, by an external rod, to a hand lever, at a convenient height for the man working the crane.

The traversing motion is similar in principle to the lifting gear, consisting of a single friction cone, keyed on the bottom of the vertical driving shaft, which communicates a backward or forward traverse when either face of the double cone is brought into driving contact, as required; the motion being transmitted to the carrying wheels through a train of worm and spur gear. The traversing gear is applied to both the carrying wheels, in order that there may be sufficient adhesion when the load overhangs either end of the crane, which would not be the case if only one wheel were driven and the load overhung the opposite end of the crane. The double cone is moved along its shaft by clutch levers, in a similar manner to the lifting and lowering gear, the clutch being worked by a hand lever. The double cones are of cast iron; but the driving cone is composed of a cone of alder wood, which is fastened by lock nuts and studs to a wrought-iron disc, screwed on the coned end of the vertical shaft. The traversing gear is carried by a bracket bolted to the foot of the centre pillar. The double cone shaft is carried at the ends by cast-iron brackets, with brass bushes, to take the end thrust in traversing: the worms are pinned on the shaft.

The jib of the crane is formed of two wrought-iron bars, stiffened laterally by diagonal trussing, and tied at the projecting end to the outer pillar of the crane by two tie rods. The bottom pressure of the jib is taken by the roller, which is carried in a cast-iron box, bolted between the projecting sides of the outer casing of the crane, and runs on the bevilled base of the cast-iron crane pillar. The base of the crane is sufficiently long to secure its stability when the maximum load is lifted over the rail, or lengthways of the crane base.

In these cranes, owing to the high speed at which the driving cord runs, the power is applied at a very long leverage over the load to be lifted. The velocity of the cord is, in all cases, 5000 feet per minute; and in the overhead traversers, the heavy loads are lifted at the rate of 1 foot 7½ inches per minute, the total leverage being slightly over 3000

to 1; so that, in this case, the driving power required to lift the maximum load of 25 tons, is only 18 lbs., irrespective of friction. When lifting light loads with the traversers, the speed of lifting is increased to 6 feet 5 inches per minute, being a leverage of nearly 800 to 1; and in the jib cranes of the wheel shop, which lift up to 4 tons, the speed of lifting is 5 feet 1½ inches per minute, giving a leverage of nearly 1000 to 1. The actual power required in the traversers for lifting a load of 9 tons, besides the snatch block and chain, has been found to be 17 lbs. acting at the circumference of the driving pulley, at the point where the driving cord acts upon it; and the total leverage over the load being 3000 to 1, the portion required to sustain the load is 6 lbs., leaving 11 lbs., as the working power required to overcome the friction of the crab gear under that load. The crab when unloaded is found to require a driving power of 1¼ lbs. to overcome its friction.

The tightening weight for the repairing shop traverser is 218 lbs., or 109 lbs. on each half of the driving cord; and this is found to be about the best working strain for keeping the rope steady and giving the required hold on the main driving pulley and the horizontal pulleys of the crab. The limit of the weight is that required to give steadiness to the transverse portion of the cord situated between the crab pulleys and the end of the traverser, which is unsupported for a length of about 80 feet when the crab is close to one end of the traverser.

The driving cords employed are soft white cotton cords, ⅝ inch diameter when new, and weighing about 1⅛ ounce per foot: they soon become reduced to 9-16ths inch by stretching, and are found to last about eight months in constant work. In the overhead traverser, which has been in constant work in the boiler shop for about three years with a single crab arranged to lift 6 tons, a smaller cord of about ⅜ inch diameter was originally used: it was, however, found desirable to adopt a cord of ½ inch diameter afterwards. The total length of each of the two driving cords in the repairing shop is 800 feet; in the wheel shop, 320 feet; and in the boiler shop, 560 feet. The wear and tear of the cord is considered to be mainly influenced by the bends to which it is subjected in its course; and the pulleys over which it is bent are, therefore, made none of them less than 18 inches diameter, or about 30 times the diameter of the cord; excepting only the presser pulleys, of 8 inches diameter, for pressing the cord into the grooves of the driving pulleys in the overhead traversers. In the jib cranes the cord has eleven bends at all times, whether the two cranes are working or not; and in the repairing shop traversers, the cord has twelve bends when both cranes are not working, sixteen when both are lifting or cross-traversing alone, and twenty when both cranes are cross-traversing and also lifting.

The groove of the driving pulley is made V shaped, at an angle of 30 degrees, and smaller at the bottom than the cord; so that the cord is gripped between the inclined sides, and does not reach the bottom of the groove. In the guiding pulleys the groove is made half-round at the bottom, with the same radius as the section of the cord; and in the pressure pulleys the bottom of the groove is rounded out with rather a longer radius.

The cord is supported at intervals of 12 to 14 feet by fixed slippers of a plain trough section, in which it lies whilst running. They are

of cast iron, flat in the bottom, which is 1¾ inch wide, and with side flanges, as shown in the full-size section: the ends are bell-mouthed. These slippers are fixed 1½ inches below the working level of the cord on the driving side, so that the driving wheels pass clear above the slippers in the traversing of the crane, and lift a portion of the cord out of them successively in passing.

In experiments made with a number of slippers carrying different weights, the friction between the cord and the slipper was found to be about two-fifths of the load; but as the total weight of that portion of the cord which rests on slippers is only 50 lbs., and the whole friction consequently amounts to only 20 lbs., it is not considered worth while to complicate the system by the introduction of pulleys for supporting the cord. No care in oiling is required as regards these bearing slippers used in transmitting the power along the shop, as is the case in the power cranes driven by continuous longitudinal shafting where tumbling carriers are required, or where heavy cords at low velocities are used, requiring carrying pulleys, the bearings of which need regular oiling. By means of pull cords passing from end to end of the shop, the main driving gear for each pair of traversers can be stopped at any time by the men working the traversers; so that when the cranes are not working, the whole of the high speed gearing stands idle.

The action of these cranes is very smooth and easy, and all the movements are readily under control.

Mr. Ramsbottom showed one of the cast-iron slippers for carrying the driving cord of the crane, together with a piece of the cotton cord employed for the purpose, and also a piece that had been working on the 25-ton crane; it had not been in use many months, but was calculated, from present experience, to last about eight months before requiring renewal.

Mr. J. Fernie had had an opportunity of seeing the cranes in use, and was greatly pleased with their construction and action. The jib crane was most convenient for taking a pair of wheels out of the lathe and conveying it to any other spot with the least possible trouble; and the traversing crane also was of great advantage for lifting an entire engine and shifting it from one line of rails to another. He enquired whether any provision was made for preventing the driving cord from slipping off the several pulleys over which it passed, and whether any accident had occurred from that cause or from the rope breaking.

Mr. Ramsbottom replied, that one accident had occurred with the six-ton crane in the boiler shop not long after it began to be used, in consequence of the driving cord slipping off one of the pulleys, and sweeping the man off the crane platform. Now, however, guards had been added to the pulleys, to catch the cord in the event of its slipping off, so as to prevent such an occurrence happening again.

The Chairman enquired what saving in labour had been effected in the wheel shop by the use of the new crane in place of the ordinary cranes used for such purposes.

Mr. Ramsbottom replied, that there were previously two dozen pairs of blocks and ropes employed in the wheel shop, requiring a large number of labourers to work them; whilst now the two traversing jib

cranes alone, with two men to work them, did the whole work of the shop and very much quicker than before; and £300 a year was saved in the piecework prices of the work done in that shop alone by the use of the new cranes.

Mr. E. A. Cowper observed that a light driving cord was the only plan compatible with a high speed of driving, as a heavy cord or chain would soon wear out by its own weight. The mode of reversing the motion, by merely deflecting the driving cord into one or other of the two grooves of the driving pulleys, was exceedingly simple and efficient; and the arrangement was also very simple for increasing the length of surface of contact of the cord with the pulley to meet the requirements of a heavier load.

Provisional Protections Granted.

[*Cases in which a Full Specification has been deposited.*]

2873. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in the manufacture of ornamental chairs,—a communication.—*November* 17*th*.

2879. William Snell, of Clement's-inn, Strand, impts. in brick and tile making machinery, — a communication.—*November* 18*th*.

2927. François Pfanhauser, of Winsley-street, impd. process of tanning.—*November* 23*rd*.

2939. Ward Ryder, of St. John's-square, Clerkenwell, burning paraffine and such like oils in lamps, chandeliers, and as night lights, by means of an inconsumable metalikos wick or burner, with or without a smoke chimney.—*November* 24*th*.

3019. George Haseltine, of Southampton-buildings, impd. combined infant tender and exercising apparatus,—a communication.—*December* 5*th*.

3042. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in the manufacture of illuminating gas,—a communication.—*December* 6*th*.

Cases in which a Provisional Specification has been deposited.

1902. Albert Kistemann, of the City, impts. in burners or apparatus applicable to lamps in which petroleum and such like oils are used,—a communication.—*July* 30*th*.

2009. Hugh Dyer, of Liverpool, impts. applicable to chimney tops and ventilators, and apparatus for cleaning the same and flues generally.—*August* 12*th*.

2153. John Hays Wilson, of Liverpool, impts. in breech-loading cannon,—a communication.—*September* 2*nd*.

2302. Stephen Bates, of New Radford, Nottingham, impts. in the manufacture of lace or other fabrics, and in the machinery or apparatus employed therein.—*September* 20*th*.

2484. James George Beckton, of Whitby, Yorkshire, impts. in heating retort and other ovens for the distillation of shale, coal, and other substances.—*October* 10*th*.

2500. William Gilbert, of Enfield, Edwin Cooper, of London, and George Rowland Webster, of Sheffield, impts. in apparatus for indicating and giving alarm in case of ac-

cidental fire; applicable to public buildings, ships, houses, and such like places.—*October* 11*th.*

2513. Isaiah Williams, of Birmingham, impd. revolver,—a communication. —*October* 12*th.*

2527. Michael Henry, of Fleet-street, impts. in steam machinery for rolling roads or ways, and in other engines, carriages, and apparatus propelled by steam on common roads, ways, and surfaces,—a communication.—*October* 13*th.*

2538. Richard Wright, of Barge-yard, Bucklersbury, impts. in preparing saccharine matters.

2540. Orin Lewis Hopson and Heman Porter Brooks, of Waterbury, Connecticut, U.S.A., impd. machine or apparatus for pointing wires or rods for pins and other articles.

The above bear date October 14*th.*

2565. William Edward Newton, of Chancery-lane, impts. in the construction of marine steam boilers,—a communication.—*October* 17*th.*

2578. William Clark, of Chancery-lane, impts. in presses for compressing substances for baling and for other purposes,—a communication. —*October* 18*th.*

2586. Auguste Clavel, of Paris, impt. in the means of holding or supporting glasses, shades, and reflectors used with lamps and burners.—*October* 19*th.*

2595. Charles Brothers, of Leamington, impts. in extinguishing fires.—*October* 20*th.*

2607. Arthur Reynolds, of Baghillt, Flintshire, impd. mode of manufacturing sulphuric acid.

2612. George Edmund Donisthorpe, of Leeds, impts. in fixing or securing the rail on tramways used when getting coal and other minerals by machinery.

2614. George Edmund Donisthorpe, of Leeds, impts. in obtaining grease from wash waters.

The above bear date October 21*st.*

2618. Henry Bird, of Wakefield, Yorkshire, impd. methods of, and apparatus for, stopping locomotive steam engines and railway carriages, by the application of steam power to the working and management of railway breaks.—*October* 22*nd.*

2642. George Edmund Donisthorpe, of Leeds, impts. in machinery for combing wool and other fibres.

2644. William Clark, of Chancery-lane, impts. in rotary engines or apparatus; applicable also as a pump or blowing apparatus,—a communication.

The above bear date October 25*th.*

2647. Robert William Wilton, of Oakley-square, impts. in the construction of roofs, walls, partitions, bridges, fences, floors, and the ribs or framing of ships and boats.

2648. Johann Ernst Friedrich Lüdeke, of Stonefield-street, Islington, and Daniel Wilckens, of Union-square, Borough, impts. in motive power by capillary attraction.

The above bear date October 26*th.*

2663. William Congalton, of Austin-friars, impts. in fitting sails to ships and other vessels.—*October* 27*th.*

2675. Alexander Parkes, of Birmingham, impts. in manufacturing compounds of gun cotton, and other vegetable substances similarly prepared; also in the preparation of castor and cotton oils and gum ballata, to be used with or separate from such compounds.—*October* 28*th.*

2707. George Ashcroft, of Hendon, Sunderland, impts. in the construction of hydraulic presses employed for pressing cotton and other fibrous substances, fuel, hay, peat, and other vegetable matters and substances, and for crushing mineral substances.

2709. Edward Pilkington, of Bolton, Lancashire, impts. in machinery employed in the manufacture of wadding and waterproof fabrics.

2710. Richard Cardwell Robinson, of Cannon-street, impts. in semaphoric signals, applicable to railway carriages.

The above bear date November 2*nd.*

2718. Samuel Davies, of Eardisley, Herefordshire, impts. in thrashing machines.

2720. Edward Thomas Hughes, of Chancery-lane, impts. in the manu-

facture of hats, caps, bonnets, or other coverings for the head,—a communication.

2722. Edward Griffith Brewer, of Chancery-lane, impts. in inkstands, —a communication.

2724. Joseph Grindley Rowe, of Queen-square, Westminster, impd. safety apparatus, applicable to railway trains.

2726. William Bayliss, of Wolverhampton, impts. in machinery for punching, pressing, and shearing metals.

The above bear date November 3rd.

2728. Eli James Harrison, of Birmingham. impts. in attaching the inside handles of carriage doors to their spindles; which impts. may also be applied to the attaching of door and other knobs to their spindles.

2729. James Dodge, of Manchester, impts. in the manufacture of metal "blanks" which are to be subsequently employed in the manufacture of files, and in apparatus for the same.

2730. Henry Binnel Harris and John Philip Thomson, of Liverpool, impts. in cigars.

2731. Francis Stephen Gilbert, of Whitechapel, impts. in tools for screw-driving, boring, and drilling.

2732. Felix Lievin Bauwens, of Walworth, impts. in cooking food.

2734. Frederic Yates, of Birmingham, impd. apparatus for generating combustible gases.

2736. Alexander John Fraser, of Water-lane, London, impts. in apparatus for stamping or marking vamps, toe caps, and other parts of boots and shoes, which apparatus is also applicable to stamping or marking other articles of leather.

2738. Matthew Piers Watt Boulton, of Tew-Park, Oxfordshire, impts. in obtaining motive power from steam and aeriform fluids and liquids.

The above bear date November 4th.

2740. John Sullivan, of Chancery-lane, impts. in the construction of oil lamps, and in glasses to be used in connection therewith.

2742. James Roger Crompton, of Elton, Lancashire, impts. in embossing or indenting tissue or other paper with a pattern in imitation of laid water marks or other designs.

2744. Martyn John Roberts, of Pendarren, Brecon, impts. in machinery or apparatus for sprinkling liquids over wool, cloth, and other substances.

The above bear date November 5th.

2747. James Denoon Young, of Duke-street, Adelphi, impts. in the construction of rolled iron railway bars or metals, girders, beams, joists, and angle irons.

2750. George Duncan, of Liverpool, impts. in printing machines.

2751. William Thrift, of Penny-fields, Poplar, impd. rotary engine, pump, or blast.

2752. David Cullen, of Bolton, impts. in the manufacture of oakum, which are also applicable to 'teasing' wool, hair, or similar fibrous materials.

2754. Alexander Steven, of Glasgow, impts. relating to hydraulic presses.

2756. Richard Archibald Brooman, of Fleet-street, impd. packing for stuffing boxes,—a communication.

2758. John Martin Stanley and Jabez Stanley, of Sheffield, impd. method of blowing cupolas, blast furnaces, refineries, smiths' furnaces, refiners, smiths' fires, and other furnaces.

2760. Alfred Vincent Newton, of Chancery-lane, impd. manufacture of hooped skirt,—a communication.

2761. Charles Thomas Burgess, of Brentwood, impts. in portable centrifugal pumps.

2762. Arthur Field, of Lambeth-marsh, impts. in the manufacture of night-lights.

2763. Gustavus Palmer Harding, of Cornhill, and Lynall Thomas, of Union-street, Berkeley-square, impts. in guns and fire-arms.

The above bear date November 7th.

2764. William Bridges Adams, of Holly Mount, Hampstead, impts. in locomotive engines and trains, for the purpose of diminishing wear and risk on railways, tramways, and common roads.

2765. Robert Montague, of Cowley-

street, Westminster, impd. apparatus for holding and regulating the cords or bands of window blinds.

2766. Richard Rimmer, of Crowe Hall, near Ipswich, impd. apparatus for drawing off liquids.

2767. John Henshaw, of Salford, impd. method of, and apparatus for, signalling and giving alarm on railways.

2768. John Hurt and Henry Tonge, of Sowerby Bridge, near Halifax, impts. in apparatus for grinding corn.

2771. William King Hall, of Sheerness, impd. method of raising screw propellers.

2772. August Bechem, of Duisburgh, Prussia, and Hermann Wedekind, of Dunster-court, Mincing-lane, impts. in rolling metals, and in the machinery or apparatus to be employed therein.

2773. John Henry Johnson, of Lincoln's-inn-fields, impts. in the treatment of yarns or threads and textile fabrics, composed of flax, hemp, or cotton; and in the apparatus employed therein,—a communication.

2774. James Okey, of Stroud, impts. in boots and shoes.

2775. John Bell, of Hammersmith, impts. in chimney pots for the prevention of down draft, and for curing smoky chimneys.

2776. Adolphe Moreau, of Chancery-lane, impts. in extracting silver from lead,—a communication.

2777. Sven Rydbeck, of Sköfde, Sweden, impts. in breech-loading fire-arms and cartridges.

The above bear date November 8th.

2778. John Davis Welch and Alfred Phippen Welch, both of Gutter-lane, impd. mode of strengthening and giving a flexible finish to the brims of straw hats.

2779. George Bell Galloway, of Liverpool, impts. in the production of motive power by the use of atmospheric air in connection with water under hydraulic pressure, and in means of preventing boiler explosions.

2780. Stephen Dixon, of Nottingham, the construction and arrangement of an impd. letter, paper, invoice, or bill book file.

2781. John Robinson, of Liverpool, impts. in the construction of ships and other navigable vessels.

2782. Samuel Cartwright Reed, of Fleet-street, impts. in the construction of traps for drains, sinks, gulleys, and other places where traps are applied.

2783. James Rae, of New-cross, impts. in the means or apparatus for transporting or conveying sea water to inland places.

2784. James Thompson, of Bilston, impts. in the manufacture of gun barrels and ordnance.

2785. John Dale and Heinrich Caro, of Manchester, and Carl Alexander Martius, of Warrington, impts. in obtaining coloring matters for dyeing and printing.

2786. William Edward Newton, of Chancery-lane, impd. filter or press,—a communication.

The above bear date November 9th.

2787. Francis Lane, of Wrotham Rectory, Seven Oaks, impd. cap or stopper for soda water and other bottles.

2790. Robert Barlow Cooley, of Nottingham, impts. in the manufacture of hats, caps, and bonnets, or other coverings for the head; and in apparatus employed in such manufacture.

2792. Morris West Ruthven, of Harlow-villas, East India-road, impts. in steering apparatus.

2793. Edward Joseph William Parnacott, of Leeds, impd. machinery for shaping and sharpening saws.

2794. John McCall, of Houndsditch, and Bevan George Sloper, of Walthamstow, impts. in preserving fresh meat, poultry, game, and fish; and in vessels employed therein.

2795. Thomas Latham Boote and Richard Boote, of Burslem, impts. in the manufacture of pottery and such like wares.

2796. Jesse Simes, of Tonbridge, Kent, impts. in steam and other motive-power engines.

2797. Henry Brockett, of Sydenham, impts. in the permanent way of railways.

2798. Leonard Cooke, of Horwich, Lancashire, impts. in the manufac-

ture of paper, and in the machinery employed therein; also in the manufacture of paper cloth and woven fabrics.

The above bear date November 10th.

2799. George Alfred Henty, of Barmouth, North Wales, impts. in the building or manufacture of torpedo rams.
2800. William Willis, of Birmingham, impts. in processes for copying or reproducing, by the agency of light, drawings, engravings, lithographs, and photographs, and written and printed documents.
2801. William Lingham Lees, of Aston, near Birmingham, impd. composition or cement for uniting or joining substances together, and for other purposes.
2802. George Dixon, of Birmingham, impts. in mills for crushing sugar and other hard substances,—a communication.
2803. William Clark, of Chancery-lane, impts. in the means and apparatus for generating motive power,—a communication.
2804. William Clark, of Chancery-lane, impts. in looms,—a communication.
2805. John Cockshott, of Preston, impd. machine or apparatus for cleaning forks and spoons.
2806. George Smith, of Bradford, Lancashire, impts. in machinery or apparatus for drying or desiccating materials or substances containing moisture.
2807. John Kinniburgh, of the Shotts Iron Works, Lanark, N.B., impts. in making moulds for casting, and in apparatus therefor.
2809. Francis Fearon, of Great George-street, Westminster, impd. apparatus for softening and deadening sound.
2810. William Edward Gedge, of Wellington-street, impd. moulds for moulding or casting,—a communication.
2812. Charles Mohr and Samuel Edmonds Smith, of Birmingham, impts. in cages for birds, squirrels, and other animals.
2813. Edward Richardson, of Ravensthorpe, Mirfield, Yorkshire, impts. in means and apparatus for producing or effecting fog signals.
2814. Charles William Heckethorne, of Park-road, Peckham, impts. in the means of, and apparatus for, working ships' pumps, and for preventing vessels from foundering.
2815. James Thorne, of Austin Friars, impts. in washing machines.
2816. Douglas Symonds Sutherland, of Great George-street, Westminster, impts. in machinery for compressing gunpowder for blasting or other purposes, and in cartridges for blasting.
2817. John Keats and William Stephens Clark, both of Street, Somersetshire, impts. in sewing machines.

The above bear date November 11th.

2818. George Davies, of Serle-street, impd. knapsack supporter,—a communication.
2820. William Fisher, of Hyde-park, impd. apparatus or mechanism for securely closing adhesive envelopes, and for affixing stamps to letters and envelopes.
2821. Francis Adams Papps, of Bow, impts. in malt liquors as tonics.
2822. John McCloskey, of New York, impt. in sewing machines.
2823. Charles Shirley Cadman, of Burlington-arcade, impt. applicable to whips, umbrellas, parasols, walking sticks and canes.
2824. Edmund Freeman Woods and James Samuel Cocksedge, of Stowmarket, impts. in apparatus used for feeding millstones.
2825. Henry William Ripley, of Bradford, impts. in preparing wool and hair for the manufacture of yarns and piece goods.
2826. Charles Cotton, of Jersey, and William Nunn, of St. George-street East, impts. in apparatus for facilitating communication between passengers and guards of railway trains.
2827. Charles Esplin, of Tyer-street, Lambeth, impts. in apparatus for regulating the supply of gas.
2828. Thomas Jones, of Manchester, impts. in boilers for heating rooms or buildings, conservatories, and similar places.
2829. Peter Armand le Comte de Fon-

tainemoreau, of Paris, impts. in looms for weaving,—a communication.

2830. William Edward Gedge, of Wellington-street, impts. in pumps,—a communication.

The above bear date November 12th.

2831. George Bell and Robert Lüthy, of Bolton, a process for obtaining dense and "flawless" castings of metals and solid blocks of other substances, particularly desirable in the production of ingots for forgings, heavy pieces of ordnance, and hydraulic press cylinders.

2832. George Edward Noone, of Hastings, impts. in machinery for deodorizing and utilizing the sewage of towns, and in the treatment of other refuse to be combined therewith, both liquid and solid, for manure and chemical use.

2833. George Needham, of Old Change, impt. in ladies' dresses.

2834. Robert Gardner, of West Bromwich, impts. in the manufacture of wrought-iron boilers for brewing, washing, and other purposes.

2835. John Farrar and Joseph Farrar, of Elland, Yorkshire, impts. in card covering for carding fibrous substances.

2836. Robert Harlow and William Jolley, of Heaton Norris, near Manchester, impts. in cocks and valves.

2837. John Matthias Hart, of Cheapside, and Robert Purkis, of Cheam, Surrey, impts. in means or apparatus for lubricating railway carriage and other axles and bearings or rubbing surfaces.

2838. Charles Langford Oliver, of Child-Okeford, near Blandford, impd. apparatus for brushing the hair.

2839. John Firth, of Sheffield, impts. in the manufacture of steel and iron.

2840. Jacques Jules Renous-Céré, of Golden-square, impts. in the manufacture of manure.

2841. Thomas Edward Vickers, of Sheffield, impts. in the manufacture of steel castings.

2842. Michael Henry, of Fleet-street, impts. in the means of, or appliances for, treating bodily injuries, affections, and disorders, when atmospheric air is to be excluded from the part affected,—a communication.

2843. Nicolas Bailly, of Vesoul, France, Charles Durand, of Jussey, France, George Howard Mesnard, of Wandsworth-road, and Zacharie Poirier, of South Lambeth, impts. in the application of rolling friction to the axle-boxes and journals of running shafts and axle-trees of machines and vehicles of all descriptions, for lessening the resistance to the motion.

The above bear date November 14th.

2844. Arthur Charles Henderson, of Charing-cross, impd. apparatus or receptacle for storing grain,—a communication.

2845. George Robinson, of Kingswinford, impts. in moulds for casting pipes, columns, and other articles.

2846. Jean Joseph Moutié, of Paris, impts. in treating benzole, or its principal composing hydrocarbons, such as benzine, toluene, or xylène; applicable also to the treatment of other hydrocarbons.

2847. Gregory Culling Attree, of Wood-street, Cheapside, impd. scarfs for the neck.

2848. Prosper Lachéz, of Brussels, impts. in looms for weaving carpets, and other pile fabrics.

2849. Job Mimmack Smith, of Manchester, impts. in crinoline skirts.

2850. James Bullough, of Baxenden, near Accrington, impts. in looms for weaving.

2851. Charles Vero, of Atherstone, impts. in the manufacture of hats.

2852. Arthur Wall, of Clapton, impd. combination or impd. combinations of materials to be used as fuel.

2853. John Philip Nolan, of Woolwich, impts. in the manufacture of projectiles by cooling them, either wholly or partly, from the interior.

2854. John Rowley, of Grosvenor-terrace, Camberwell, impts. in the manufacture of printers' ink.

2855. Thomas Restell, of Norwood, impts. in breech-loading fire-arms.

2856. Siegerich Christopher Kreeft, of Fenchurch-street, impts. in the manufacture of iron and steel,—a communication.

The above bear date November 15th.

2857. Richard Holiday, of Bromley, Middlesex, impts. in the mode of locking or securing the levers used to work railway signals and points.
2858. Marie Destrem, of Paris, impd. composition for painting.
2859. Richard Allinson, of Smethwick, and Henry Lea, of Birmingham, impts. in machinery for grinding and stripping or polishing files and file blanks; which said said improvements are also applicable to machinery for grinding, shaping, and polishing other articles.
2860. James Gothard and Herbert Garland, of Birmingham, impts. in fire bars.
2861. Frederick Carr Parker, of Dundee, impts. in the preparation of jute and other fibrous substances.
2862. Jules Aubin, of Paris, impd. millstone for grinding corn and other substances.
2864. William Edward Newton, of Chancery-lane, impts. in the manufacture of soda,—a communication.
2865. Henry Grafton, of Brompton-square, impts. in roller and revolving shutters.
2866. James Hughes, of Wellington-place, Bethnal-green, impts. in jacquard cylinders.
2867. Henry Grafton, of Brompton-square, impts. in machinery for cutting wood into mouldings, laths, and other forms.

The above bear date November 16th.

2868. George Score, of Clarendon-gardens, Maida-hill, and Robert William Sievier, of Soho-square, impts. in the means of communication for railway travellers with the guard.
2871. Thomas Rowatt the younger, of Edinburgh, impts. in lamps for burning paraffine, belmontine, petroleum, and other like hydro-carbon fluids.
2872. John Henry Johnson, of Lincoln's-inn-fields, impd. mode of treating the moulds or packets employed in the manufacture of gold leaf and other metal foils,—a communication.
2874. Henry Wilson, of Victoria Works, Blackfriars-road, impts. in machinery for sawing, adzing, and boring holes in sleepers for railways.
2875. Henry Wilson, of Victoria Works, Blackfriars-road, impts. in machinery for moulding and planing wood.

The above bear date November 17th.

2877. James Fisher, of West Bromwich, impts. in heating furnaces used in the manufacture of welded iron tubes.
2878. Stephen Sharp, of Melton-place, Euston-square, impts. in ships' anchors.
2880. Julius Behrends, of Philpot-lane, impd. means and apparatus for raising and drawing off liquids,—a communication.
2881. William Sargeant, of Brafield-on-the-Green, Northamptonshire, impts. in the construction of horse hoes, and seed or other drills.
2882. Theophilus Alexander Blakely, of Montpelier-square, impt. in working guns.
2884. Michael Henry, of Fleet-street, impts. in the mode of, and apparatus for, carbonizing wood, and performing other operations in which substances are treated by flame or heat,—a communication.
2885. William Clark, of Chancery-lane, impts. in balances for weighing letters and other light articles,—a communication.
2886. John Webster and John Langham, jun., of Leicester, impts. in machinery for producing knitted or looped fabrics.
2887. William Wilson, of Newcastle-upon-Tyne, impts. in the manufacture of hats.
2888. James Petrie, of Rochdale, impts. in valves for regulating the flow of steam in steam engines.
2889. Septimus Piesse, of New Bond-street, impts. in apparatus for creating and projecting cold vapours.
2890. Edward Stewart Jones, of Liverpool, impd. means of obtaining and applying motive power for the propulsion of navigable vessels.

The above bear date November 18th.

2891. Joseph Phillips, of Great Suffolk-street, Southwark, impts. in apparatus for the prevention of accidents in connection with steam boilers.

2893. Abraham Henthorn Stott, of Oldham, impts. in steam boilers or generators.

2894. William Virgo Wilson, of Jubilee-street, Mile-end, and James Alfred Wanklyn, of Finsbury-circus, impts. in the preparation of purple-dye stuffs.

2895. John Pitman, of Brislington, Somersetshire, impd. instrument for determining latitude and longitude, and for solving problems in navigation, nautical astronomy, and geometry,—partly a communication.

2896. James Easton, jun., of the Grove, Southwark, impd. apparatus for the manufacture of paper pulp,—partly a communication.

2897. John Gaukroger, of Hebden-bridge, Yorkshire, and Albert Gaukroger, of Hawksclough, near Hebden-bridge, impts. in looms for weaving.

2898. William Palmer, jun., of South-weald, Essex, impts. in cases for carrying pipes and tobacco.

The above bear date November 19th.

2899. John Mackintosh, of North Bank, Regent's-park, and Augustus Henry Thurgar, of Norwich, impts. in propelling boats, and in apparatus connected therewith.

2900. Thomas William Panton and Hugh Panton, of Sunderland, machine for machining the ends of butts of bent iron plates, which will give them, even after being bent or set, an almost mathematically correct geometrical form, and cause them to fit and butt against each other with extreme accuracy.

2901. William Edward Newton, of Chancery-lane, impts. applicable to fireplaces for heating apartments,—a communication.

2902. William Martin, of Birmingham, impts. in sewing machines.

2903. Henry Willis and George Rice, of Worcester, impts. in sewing machines, and in winders for sewing machines.

2904. John Griffiths, of Litchurch, near Derby, impts. in machinery or apparatus to be used in the manufacture of iron and steel.

2905. Stephen Bourne, of Harrow, impts. in vent pegs and valves, chiefly applicable for regulating the passage of air or gas, or other fluids, into and from vessels containing beer and like liquids.

The above bear date November 21st.

2906. Alfred Vincent Newton, of Chancery-lane, impt. in the manufacture of sugar, and in the machinery to be used therein,—a communication.

2907. James Leetch, of Oxford-street, impt. of breech-loading fire-arms and cartridges to be used therewith.

2908. Henry Eckersley, of Oldham, impts. in the method of weaving piled fabrics termed "satteens."

2909. John Wylie and James Rew, of Glasgow, impts. in apparatus for the manufacture of "impressed-gold" and similar paper hangings.

2910. Gustav Köttgen, of Barmen, Prussia, impts. in the manufacture of pockets; which impts. are also applicable to the manufacture of bags for containing cash, samples, or for other similar purposes.

2911. Hector Leon Maquet, of Paris, impts. in instruments or apparatus for stamping or pressing in colors and otherwise.

2913. William Ibotson, of Wraysbury, Bucks, impts. in the preparation of pulp for the manufacture of paper.

2914. Paulin Etienne Gay, of Paris, impd. machinery for excavating and cutting rock and stone in general.

2915. Thomas Shorey and George Gibson, of South Shields, impts. in reefing and furling sails.

2916. Jean Claude Louis Durand, of Lyons, France, impts. in the manufacture of coloring matter, and in treating fabrics and materials dyed or printed therewith.

2917. Robert Morrison, of Newcastle-upon-Tyne, impts. in steam hammers, anvil blocks, and their foundations.

2918. Thomas Makdougall Brisbane, of Liverpool, impd. power engine, to be worked by steam or other elastic fluid.

The above bear date November 22nd.

2919. Nathan Hodgson, of New Barnet, impd. apparatus for washing, wringing, rinsing, and mangling.

2921. Peter Garnett, of Cleckheaton, impts. in machines for opening and scribbling fibrous substances, and in the tools employed in the construction of inserted toothed wire rollers.
2922. John Paley and Thomas Rawsthorne, of Preston, Lancashire, impts. in mules for spinning.
2923. Francis Millns, of Poole, Dorsetshire, impd. method of cooling liquids, particularly applicable to the cooling of wort.
2924. Strother Price, of Highbury, impd. apparatus for lifting, or assisting to lift, window sashes and other like frames.
2926. John Sacheverell Gisborne, of Liverpool, impts. in mechanical apparatus by which motion can be communicated or transmitted from one place to another, and between different parts of a ship or other structure, to exhibit orders, messages, or signals.
2928. Adolph Oberdoerffer, of Regent-street, impt. in butt-pieces for cigar-holders.
2929. Peter Haggie, of Gateshead-on-Tyne, and Peter Gledhill, of Newcastle-on-Tyne, impts. in machinery employed when getting coal, stone, and minerals.
2930. George Brunton, of Sheffield, impts. in means or apparatus for smoothing and polishing.

The above bear date November 23rd.

2931. Echlin Molyneux, jun., of Seaview, Enniskerry, Ireland, impts. in travelling railways.
2932. John Kissack, of Liverpool, impts. in warming and ventilating apparatus.
2934. Frederick Sang, of Buckingham-street, Adelphi, impd. ventilating cupola chandelier.
2935. Robert Wheble, of Pall-mall East, impts. in the means of, and apparatus for, communicating between passengers, guards, and drivers of railway trains.
2936. Thomas Perkins, of Hitchin, impts. in apparatus for washing coprolites.
2937. John White, of Finchley, impts. in means or apparatus employed in purifying, changing the temperature, and impregnating atmospheric air; which impts. are also applicable to the purification or separation of gases or vapours; and part of which impts. is also applicable in obtaining motive power for other purposes.
2938. Wedderspoon Keiller, of Glasgow, impts. in the preparation of marmalade and similar condiments, and in the machinery, apparatus, or means employed therefor.
2940. Louis Valant, of Paris, impts. in apparatus for feeding steam boilers and other reservoirs for liquid, and for regulating the level therein,—partly communications.
2941. Pierre Elie Gaiffe and Eugene Zglinicki, of Paris, impd. apparatus for engraving.
2942. Edward Cottam, of Battersea, impts. in hydraulic presses.
2944. William Clark, of Chancery-lane, impts. in the metallic ornamentation of feathers, plumes, and other like articles,—a communication.

The above bear date November 24th.

2946. William Ward, of Newgate-street, impts. in table covers.
2947. Robert William Sievier, of Rochester-road, Camden Town, impts. in cannons, mortars, or guns.
2948. Louis Leisler, of Glasgow, impts. in obtaining bromine and bromides, and in apparatus therefor.
2949. John Grundy, of Tyldesley, Lancashire, impts. in apparatus for heating rooms or buildings.
2950. Thomas Knowles, of Manchester, impts. in switches or points for railways.
2951. Charles Reeves, of Birmingham, impts. in breech-loading fire-arms, and in cartridges for breech-loading fire-arms; a part of which impts. may also be applied to ordnance.
2952. Timothy Bush Laws, of Well-close-square, St. George's-in-the-East, impts. in pipes for smoking.
2953. Leandro Crozat, of Seville, impts. in photographic processes, and in portraits or images produced thereby.

The above bear date November 25th.

2955. Charles Hartley, of Salford, and

Thomas Hall, of Manchester, impts. in looms for weaving.

2956. John Evans, of Birmingham, impts. in bells.

2957. Mark Frederick Heinzmann, of Bradford, impts. in apparatus for eyeletting boots, shoes, and other articles requiring eyelets,—a communication.

2958. John Rowley, of Leeds, impts. in machinery or apparatus for separating or recovering the fibres of wool from fabrics or materials composed of wool combined with cotton or other fibres.

2959. Laurentius Andreas Waldemar Lund, of Chandos-street, impts. in the manufacture of studs, buttons, brooches, bracelets, earrings, baskets, vases, and other such like articles and fastenings.

The above bear date November 26th.

2960. Thomas Greenhalgh, of Manchester, impts. in steam engines and rotary pumps.

2961. George Newsum, of Hunslet, Leeds, impts. in hauling apparatus, especially applicable to agricultural purposes.

2962. William Elliott Carrett, of Leeds, John Warrington, of Kippax, Yorkshire, and John Sturgeon, of Leeds, impts. in machinery for cutting coal, stone, or other minerals.

2963. James Roger Crompton, of Elton, Lancashire, impts. in machinery for the manufacture of paper.

2964. John Smith, of Cheetham, Manchester, impts. in preparing linen, jute, and other textile fabrics to be oiled for packing purposes.

2965. Lodi Montaigne, of Paris, impd. turbine for drying sugar and other watery matters.

The above bear date November 28th.

2968. William Jackson, of Sunderland, and John Glaholm and William Glaholm, of Bishopwearmouth, impts. in the construction of hydrobeer pumps.

2970. Robert Maynard, of Whittlesford, impts. in machinery for cutting, separating, grinding, and crushing agricultural produce.

2971. Alice Isabel Lucan Gordon, of Hyde-park, impts. in hats.

2972. George Axton, of Shepherd's Bush, and John Leach, of Hounslow, impd. apparatus and machinery for making bricks.

2973. Carl Johann Falkman, of St. Petersburg, impts. in apparatus for distilling and purifying spirituous liquors; also applicable to the purification of other volatile fluids.

2975. George Davies, of Serle-street, impts. in machines for sweeping roads or ways,—a communication.

2976. Arthur Wheatley, of Upper Montague-street, Montague-square, impts. in obtaining heat for generating steam in steam boilers.

2977. Joseph Duris de Boulimbert, of Paris, a new kind of cigar, made of other materials than tobacco.

2978. Juste Pinaud, of Paris, impd. apparatus to be applied to carriages for controlling or indicating the time engaged and the amount of fares.

2979. Alfred Vincent Newton, of Chancery-lane, impd. machinery for pressing and baling goods,—a communication.

2980. Archibald Edward Dobbs, of Victoria-road South, Hampstead, impd. apparatus for taking deep sea soundings without the use of a line, and for bringing up specimens of the sea bottom and sea water from the greatest depth.

The above bear date November 29th.

2981. Richard Farrall Dale, of Shoe-lane, apparatus to be employed in drawing off and measuring paraffin and other oils; applicable also in drawing beer and other liquids, and measuring the same.

2983. William James Matthews, of Birmingham, impts. in breech-loading fire-arms, and in converting muzzle-loading fire-arms into breech-loading fire-arms.

2984. Michael Henry, of Fleet-street, impts. in means or apparatus for indicating, signalling, registering, measuring, and stopping escapes of gas,—a communication.

2985. Henry Caunter, of Stornoway, Rosshire, impts. in preserving ships' bottoms and other surfaces under

water, and in preventing the formation of barnacles and other accumulations thereon; which improvements are also applicable as a preservative from the effects of moisture or damp, and as a cure or preventive of the scab in sheep, and a protection to them from the effects of damp and exposure.

2986. John Banger, of Oxford-street, impts. in preparing and potting the roes of fish.

2988. Eyre Massey Shaw, of Watling-street, impts. in feeding steam boilers.

2989. Abraham Hawkes, of Charlton, Dover, impts. in obtaining motive power.

2991. Richard Longden Hattersley, of Keighley, and James Hill, of Cross Hills, both in Yorkshire, impts. in looms for weaving.

2992. James McIntosh, of Dundee, impd. apparatus for giving pressure to the drawing rollers of preparing and spinning machinery.

The above bear date November 30th.

3003. Martyn John Roberts, of Pendarren, Brecknock, impts. in means or apparatus for reducing the friction now produced by the longitudinal or endlong pressure of ships' screw propeller shafts, or of any upright or inclined shafts when revolving.—*December 1st.*

3005. Thomas Wood Gray, of Margaret-street, Limehouse, impts. in pumps.

3007. George Wailes, of Stroud, and Benjamin Cooper, of Frome, impts. in apparatus to be employed in the feeding of scribbling and carding engines.

3009. Edward Alfred Cowper, of Great George-street, Westminster, impts. in machinery or apparatus for separating cotton fibre from the seed, and also for cleansing the seed after the fibre has been separated therefrom.

The above bear date December 2nd.

3011. John France, of Gloucester-terrace, Notting-hill, impts. in steam engines.

3013. Richard Archibald Brooman, of Fleet-street, impts. in apparatus for heating and cooking by gas,—a communication.

3015. Charles William Lancaster, of New Bond-street, impts. in fuzes.

The above bear date December 3rd.

3025. James Goodier and Thomas Lee, of Chester, impts. in mills for grinding grain and other substances.

3027. John Yearsley, of East Smithfield, and Edward Timbrell, of St. George's-in-the-East, impts. in apparatus for cleaning rice, and a new composition to be used therein.

The above bear date December 5th.

3031. Henry Lamplugh, of Driffield, impts. in trucks or carts for carrying and elevating sacks or other heavy bodies.

3033. William Edward Gedge, of Wellington-street, impts. in clock-work,—a communication.

3035. William Thomas Watts, of Birmingham, impts. in apparatus to be applied to furnaces for condensing and collecting products volatilized in the said furnaces.

3037. John Stephenson, of Marylebone, impts. in umbrellas, parasols, and sun-shades.

3039. John Keeling, of Aldershot, impts. in apparatus for regulating the supply of gas.

3043. William James Burgess, of Brentwood, impts. in reaping and mowing machines.

3047. William Edward Newton, of Chancery-lane, impts. in apparatus for blowing bubbles from soap-suds or other liquids to amuse children, and for other purposes, such as perfuming the atmosphere of apartments,—a communication.

The above bear date December 6th.

3049. Alexander Dallas Hall, of Glasgow, impd. compound for coating the bottoms of ships and structures wholly or partially immersed in the sea or tidal estuaries, and in the system or mode of preparing the same.—*December 7th.*

3055. James Livesey, of Cannon-street West, and John Edwards, of

Basinghall-street, impts. in the permanent way of railways.

3061. Alfred Vincent Newton, of Chancery-lane, impd. machinery for cutting soap into bars,—a communication.

3063. Ebenezer Partridge, of Smethwick, impts. in carriage axles and boxes; and an impd. tool to be used in the manufacture of carriage axles, and for forming grooves or recesses in parts of machinery.

The above bear date December 8th.

3065. William Tongue, of Wakefield, impts. in machinery for combing fibrous materials.—*December 9th.*

New Patents Sealed.

1299. William Law.
1315. James Eastwood.
1316. J. Whitley and D. F. Bower.
1326. James Dickson.
1328. André Etienne.
1335. Thomas Drew.
1337. William Halse.
1338. Collinson Hall.
1339. John Huggett.
1344. George Haseltine.
1347. R. A. Brooman.
1350. J. M. Stanley and J. Stanley.
1352. W. and S. Firth.
1353. J. Platt and E. Hartley.
1355. R. E. Donovan and R. Bowles.
1357. G. E. Dering.
1358. C. R. Humphrey and J. Hasler.
1360. Henry Ambler.
1363. L. Kimmings, G. Gibbs, and W. T. Edwards.
1369. R. Threlfall and R. W. Pitfield.
1370. W. H. Mellor
1371. Edward Myers.
1372. R. A. Brooman.
1373. R. A. Brooman.
1374. William Clark.
1382. A. H. Williams.
1385. Thomas Holden.
1387. Bondy Azulay.
1388. W. Houghton, G. Burrows, and C. Olroyd.
1391. Edward Ledger.
1392. Joseph Smith.
1393. W. T. Cheetham.
1396. Henry Hill.
1398. Jacob Snider, jun.
1400. B. E. M. Crook.
1401. James Napier.
1405. W. H. Preece.
1407. T. Aveling and T. Lake.
1408. William Clark.
1409. E. J. Hughes.
1413. William Clark.
1414. R. A. Brooman.
1416. John Beck.
1417. J. A. Wade.
1419. A. A. Larmuth.
1425. Thomas Richards.
1428. Abraham Tweedale.
1431. P. M. Parsons.
1432. Robert Oldridge.
1434. John Onions.
1436. Michael Henry.
1438. Napoleon Sarony.
1440. Frederick Tolhausen.
1441. W. Hugo and A. Domerer.
1442. J. P. Williams and T. Robinson.
1444. R. A. Brooman.
1445. W. H. James.
1448. R. Hall and J. Chambers.
1449. Honorable Susan Tuchet.
1452. P. Spence and J. B. Spence.
1455. E. G. Fitton.
1456. William Sharp.
1459. W. E. Gedge.
1460. William Martin, jun.
1461. R. A. Brooman.
1462. Richard Kendrick.
1463. J. G. Marshall.
1465. Edmond Pope.
1468. J. Brown, J. T. Way, and T. M. Evans.
1469. G. A. Burn.
1470. Benjamin Fothergill.
1472. William Tregay.
1473. P. B. O'Neill.
1475. M. A. F. Mennons.
1477. William Dawes.
1478. C. Taylor and J. Dow.
1482. R. A. Brooman.
1485. J. Fletcher and H. Bower.
1487. G. Gondelfinger and J. L. Bichet.
1488. James Lancelott.
1489. W. E. Gedge.
1493. R. W. Thomson.
1494. M. A. Muir and J. Mc Ilwham.

1498. G. H. Ozouf.
1499. G. Newton and J. Braddock.
1503. W. C. Jay.
1504. R. Bodmer and L. R. Bodmer.
1505. G. B. Morris, W. B. Price, and J. L. George.
1507. William Clark.
1508. M. E. Boura.
1511. James Hodges.
1512. J. J. Bennett.
1513. W. H. Tooth.
1514. W. H. Tooth.
1515. Thomas Agnew, jun.
1517. E. M. Boxer.
1518. W. Whiteley and G. Harling.
1520. J. H. Johnson.
1522. S. G. Hewitt.
1523. Richard Jones.
1524. J. C. Brentnall and R. Edge.
1525. R. Smith and C. Sieberg.
1526. John Jobson.
1527. Alfred Smith.
1528. George Beard.
1529. J. H. Beattie.
1531. Thomas Worsdell.
1532. Thomas Mayor.
1533. W. A. Abegg.
1535. John Thompson.
1538. W. J. Pughsley.
1541. Henry Phillips.
1542. W. Carrington and T. Turner.
1543. T. O. Dixon.
1545. James Forbes.
1546. Alfred Smith.
1547. T. J. Denne.
1548. J. H. Johnson.
1549. J. Buckle and E. Crossley.
1550. John Bottomley.
1551. E. A. Inglefield.
1556. C. Hepstonstall.
1558. C. H. Pugh.
1559. T. P. Saville.
1561. John Jones.
1567. George Carter.
1572. James Smith.
1576. Robert Cochran.
1579. Jean Bailly.
1580. James and Joseph Hinks.
1581. A. Knowles and J. Barraclough.
1588. W. A. Guy, E. Edwards, & R. W. Macarthur.
1589. R. W. Macarthur, W. A. Guy, and E. Edwards.
1591. W. D. Napier.
1592. William Brown.
1594. Benjamin Nicoll.
1595. Lord John Hay.
1598. W. E. Newton.
1599. B. G. Stevens.
1602. Charles Denis.
1604. John Askew.
1607. H. C. Steane and F. A. Steane.
1609. W. F. Thomas.
1620. William Clark.
1622. J. H. Wilson.
1629. Raymond Balans.
1630. Raymond Balans.
1635. James Combe.
1645. A. Wyley and J. Grainger.
1646. A. V. Newton.
1655. W. E. Gedge.
1663. G. H. Palmer.
1688. W. E. Newton.
1692. C. H. Collette.
1743. W. L. Wise.
1747. G. W. Pitcher.
1769. W. K. Westly.
1813. W. E. Newton.
1847. J. H. Johnson.
1855. Thomas Dixon.
1860. J. H. Beattie.
1863. G. Furness and J. Slater.
1919. F. W. Bossert.
1946. G. F. Druce.
1978. P. A. J. Dujardin.
1998. A. B. Childs.
2006. William Brenton.
2018. Edward Andries.
2060. Henry Parkes.
2061. F. G. Underhay and R. Heyworth.
2064. George Davies.
2097. Harold Potter.
2212. L. F. Goodbody.
2221. E. O. Potter.
2230. Harold Potter.
2246. George Haseltine.
2269. Charles Attwood.
2285. E. Slaughter and F. L. F. Caillet.
2306. William Wilkinson.
2326. Harold Potter.
2364. Henry Bennison.
2396. George Haseltine.
2397. George Haseltine.
2420. Edward Loysell.
2429. Samuel Bateman.
2442. G. T. Bousfield.
2443. J. and F. Johnson.
2472. George Haseltine.
2569. Johann Zeh.
2590. William Snell.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S

London Journal of Arts and Sciences.

No. CXXII. (NEW SERIES), February 1st, 1865.

ON THE PURIFICATION OF COAL GAS FROM BISULPHURET OF CARBON.

[In the following communication gas manufacturers will recognise and welcome the pen of an able and earnest friend, who has done more, perhaps, than any living man, for the improvement of their manufacture, and who now breaks a lengthened seclusion to give the world the free benefit of his latest researches.—Ed.]

More than twelve months ago, I discovered that the vapour of water and bisulphuret of carbon could not exist together at a red heat; in other words, that if steam and the bisulphuret of carbon are passed together through a red-hot tube, they mutually decompose each other, and are converted into sulphuretted hydrogen and carbonic acid, as shown in the following diagram:—

One atom of Bisulphuret of Carbon	Consist of	Are Converted into
	Sulphur, 2 atoms	Two atoms of Sulphuretted Hydrogen
	Carbon, 1 atom	and
Two atoms of Water	Oxygen, 2 atoms	One atom of Carbonic Acid.
	Hydrogen, 2 atoms	

It immediately occured to me that this fact might be usefully employed in the purification of coal gas, but I had not an opportunity of so employing it until within the last six months; during this time, however, I have not only completely demonstrated its practical value for the above purpose, but have superintended the manufacture and purification by this means of more than 15,000 cubic feet of coal gas, the whole of which was found, by the most careful experiments, to be altogether free from the slightest taint of bisulphuret of carbon.

Some persons will, perhaps, feel inclined to doubt the value of this communication, and to say "Why was a patent not taken out for the process?" To this I answer, that having been infamously duped some years since in reference to a patent for the distillation of coal, I then

resolved never again to enter upon any such mercantile speculation.* The process which I am about to describe is, however, one that may be easily and cheaply put into practice, consequently, there is no great risk attached to a preliminary essay; and when the present importance of the subject is considered, I believe that few people engaged in the manufacture of gas will hesitate to give the thing a trial. At all events I will now endeavour to furnish them with an intelligible description.

In gas-making, the coal is thrown into a red-hot retort, and the volatile matters thus formed are passed, in the first instance, into what is called the "hydraulic main," where the tar, ammoniacal liquor, and other easily condensative bodies, are separated from the gas; after which the gas passes on to the "condenser." Now it is exactly at this point that my proposed process begins: after the gas has left the hydraulic main, and before it has reached the condenser, I mix it with a suitable quantity of steam (superheated or not), and pass the mixture through a retort or tube, heated to a full cherry-red heat. The shape of the retort or tube, and the material of which it is made, are of little importance, though an elliptical is, of course, better than a circular form, and cast iron better than clay; but the length of the tube should, in every case, be so proportioned to the velocity of the current passing through it, that there is time for the mixture of steam and gas to become red hot, before it leaves the tube, to pass on, in the usual way, to the condenser. My experiments were made with a circular cast-iron tube, through which the mixture was passed at the rate of 1500 cubic feet per hour: this tube was five inches in diameter and twelve feet in length. The kind of coal used was a mixture of Pelton and Pelaw Main; and the gas, after purification by lime, was found, when burnt in a common argand burner, at the rate of five cubic feet per hour, to give a light equal to 13½ standard spermaceti candles, made by Messrs. Field, of Lambeth.

As regards the degree of heat, which I have called "a full cherry-red," I will remark that this is about equal to 1200° of Fahr., but the temperature may vary from the melting-point of soft brass to the fusing point of silver—always remarking that the swifter the current of the gases through the tube, the higher the temperature required. With respect to the quantity of steam, this, for any of the Newcastle coals, may be from 60 to 80 cubic feet per ton of coal, or, in the shape

* Let me not be misunderstood in this remark. My objection to patents relates solely to that provision of the patent law which enables dishonest persons, under the disguise of "a foreigner residing abroad," to defraud the unwary. As regards the patent law itself, no other method has ever been devised, by which the spirit of enterprise and genius may command its own reward in a civilized country. That our patent law has grave defects, I freely admit, but that these are incurable, I altogether deny; and, anyhow, for better or for worse, the law of patents is a necessary adjunct to human progress in a free country.

of water, from 3 to 4 lbs. of water per ton of coal: or, in technical language, I may say, that for every 1000 cubic feet of impure gas taken from the hydraulic main, seven cubic feet of steam, or the vapour produced by five ounces of water, must be used. An excess of steam is, however, not much to be dreaded, as it is useful during condensation.

I believe that I have here said sufficient to enable any practical man to carry out this idea, and may, therefore, safely leave the details to the peculiar views of different individuals. With reference to the presence of bisulphuret of carbon in coal gas, I have never had but one opinion, which is—that it ought to be removed, if practicable. But as to the oil of vitriol story, foisted upon the public some time ago, and still kept up through the medium of the London Corporation, I consider it a disgrace to the age we live in. That common coal gas, by chemical treatment, can be made to yield oil of vitriol; that beef and mutton, by chemical treatment, can be made to yield prussic acid; and that the air we breathe can be converted into aqua-fortis, are all facts long known to scientific men. But, burnt as coal gas is burnt; cooked as beef and mutton are cooked; and breathed as the air is breathed by the public, the oil of vitriol, the prussic acid, and the aqua-fortis become mere visionary bugbears, for the terror of fools and the gain of quacks. Formerly, when any "regular stretcher" was attempted to be passed upon our jolly Jack tars, they were in the habit of replying, "Ah! that will do for the marines;" but now I think most well-informed men, under similar circumstances, will feel inclined to exclaim, "Ah! that will do for the London Corporation." In conclusion, I cannot do better than quote the opinion of one of the first chemists of Europe upon this vitriol phantom: our present Master of the Mint, Professor Graham, at page 423 of his "Elements of Chemistry," in speaking of the impurities of coal gas, says:—"All these bodies are separated from it in the process of purification, except the naphtha vapour and the bisulphuret of carbon, which affords a little sulphurous acid when the gas is burned." Of course Professor Graham means by the word "burned," burned as the public burns gas, and not "cooked" for a "sensation banquet" at Guildhall; indeed it would, in this country, be worth a "Jew's eye" to discover a mode of converting sulphurous acid into oil of vitriol without the intervention of chemical agents.

LEWIS THOMPSON, M.R.C.S, &c.

THE CANNEL COAL OF FLINTSHIRE.

Upon more than one occasion we have directed the attention of our readers to the circumstances attendant upon the introduction into commerce of the various liquids now so well known under the name of mineral oils. The manufacture and use of these oils forms an era in commerce, both on account of the effect which has been thereby produced upon certain other branches of trade, and from the magnitude of the transactions that have arisen in connection with the substances themselves. Not more than twelve or thirteen years have elapsed since the mineral oils began to be first known in trade. In 1850, Mr. James Young took the patent which has since been the subject of perhaps the most expensive litigation that ever attended the maintenance of patent rights; and between the date of that patent and the present moment the whole commercial history of these oils is comprehended.

As the term mineral oil scarcely carries with it an explanation of the character of the liquid to which it is applied, it may be as well to explain that the liquids which bear this application are all extracted either from some variety of natural petroleum or bitumen, or from coal; it is more particularly in reference to the latter kind of mineral oil that we propose to offer some brief remarks. The Leeswood cannel coal, of Flintshire, is particularly interesting. At the time when Mr. Young obtained his patent, the question of usefully applying the various liquids produced by the chemical treatment of some natural petroleums was beginning to excite considerable attention. Mr. Young had himself succeeded in utilizing a petroleum in Derbyshire, until, indeed, he finally exhausted the supply; and, both in France and in England, many attempts had been made to turn to profitable account the products of the distillation of the schales of Autun and Dorsetshire. About 1851 or '52, a fresh impulse was given to this subject by the importation of the Burmese or Rangoon petroleum, which, although it had been known from the earliest times, and had been seen and chemically examined in Europe, had never before then been introduced in any commercial quantity; and the discovery of the now noted mineral, known as the Boghead cannel coal, near Bathgate, in Scotland, added another very important element to the question—both on account of its yielding a larger quantity of oily products than any other coal or schale then known, and because there is reason to believe that similar oils had never been before obtained, in quantity, by the distillation of coal. The Boghead coal and the Rangoon petroleum constituted the first great

staples from which commercial mineral oils were produced in England; and before the introduction of the American petroleum, within a comparatively late period, they were, indeed, the great sources of supply—the manufacture of the Boghead coal being principally, if not entirely, in the hands of James Young and Co., in Scotland, and that of the Rangoon petroleum in those of the house of Sir Charles Price and Co., of London. For many years the Boghead coal was the only substance of the kind from which oils of the desired quality could be extracted. True, the patent of Mr. Young was prohibitory to much enterprise in this direction, but the known great value of this mineral, and the profit attending its manufacture, had excited attention, and many kinds of coal schale had been made the subject of experiment without much success, when, in 1858, a new variety of cannel coal was discovered at Leeswood Green, in Flintshire, only a few miles distant from Mold.

The Flintshire coal field appears to have been worked from a remote period, as both tradition and documentary evidence prove that coals were raised from it as far back as the reign of Edward the Third; but the extent of the coal field is limited, as it is estimated to possess not more than about 60,000 acres of area. The coal seams are comparatively near the surface of the ground,—that of the main coal, which is the principal, and also the deepest worked before the discovery of the cannel coal, not being more than 125 yards below the surface. Indeed, before this discovery, it was a rare thing for a coal pit in this district to exceed 150 yards in depth.

The discovery of this valuable cannel coal is a remarkable instance of what some may be disposed to regard as a consequence of a general law, that the productions of nature always present themselves at the moment when the necessity for them begins to be pressing; and the manner of the discovery was as singular as it was fortunate. It seems that the owner or lessee of the Leeswood Green coal pits, in pursuing some investigations in the old workings, drove a small gallery to a point where there had been a complete dislocation of the coal strata, with a rise or upthrow of 25 yards in the strata which had been broken away from those in which the gallery was driven. The consequence of the disruption of the coal seams was to place in opposition to the point at which the gallery terminated, a series of strata of a different character, and in the lower of these was distinguished a peculiar kind of schale, which, from its remarkable appearance, led to further examination, and finally it proved to be the overlying schale of a series of cannel strata, together making up a seam several feet in thickness of, perhaps, the most valuable cannel coal ever discovered in Britain. It is still a question *sub judice*, whether the Boghead coal of Scotland is really a

coal or a schale. Courts of law have declared it to be a coal, at least commercially, but many eminent scientific men still maintain that it is only a highly-bituminous schale. However this may be, no question of the kind can arise concerning the Leeswood cannel coal, which is in every respect a true cannel, but yielding liquid products when distilled as abundant and as good in quality as those obtained from Boghead cannel. One of the principal characters upon which the advocates of the schale doctrine concerning the Boghead mineral rely, is the peculiar nature of the coke or residue left when the mineral is distilled. This, like the coke from acknowledged schales, contains a very large per-centage of aluminous ash, which renders it totally worthless for fuel; but the Leeswood cannel coal is free from this defect, and yields, after distillation, a compact coke, which, from one variety of the cannel, is almost unequalled in quality. In 1859—60, this coal was placed in the hands of the late Dr. Fyfe, of Aberdeen, and Mr. Keates, of London, for thorough chemical examination: lengthened reports were made by these chemists as to the quality of the coal, both as a gas coal and in respect to its oil-producing capabilities; and these reports were of such a character, that since that period the coal seems to have been gradually more and more highly appreciated.

The principal characteristic of the Leeswood cannel coal is its extreme bituminousness, to coin a word: a small piece, thrown into a fire, immediately ignites, and burns with a bright, white flame, throwing off at the same time an abundance of separated carbon; and when distilled at the gas-making temperature, it yields a large quantity of gas, of the highest illuminative power. The seam of cannel, altogether about six feet in thickness, is divided into four strata of coal, of different qualities, but all valuable, as oil-yielding coals. These are—above, a kind of coal-schale, highly bituminous, and yielding, when distilled at a low temperature, from 32 to 35 gallons of crude oil per ton; below that, what is called the smooth cannel, yielding 40 to 45 gallons of crude oil per ton, and a coke of very peculiar and valuable quality resembling the charcoal from very hard wood; next in the series—what is looked upon as the most valuable of all the strata—the Curly coal, so called, on account of its remarkable twisted fracture, which yields 75 to 80 gallons of oil per ton; and, lastly, what is known as bottom cannel,—very similar in character to the smooth cannel above, excepting that the coke is of inferior quality. These four strata make up the entire seam of the cannel, which lies at about 200 yards below the surface, upon a stratum of good ironstone, with fire-clay. The discovery of this coal was a fortunate circumstance, in relation to the manufacture of these mineral oils: before this discovery, as we have

already stated, the only indigenous substance largely used, was the Boghead coal; and as the contracts for that coal were in few hands, the manufacture of the oils was, irrespective of Young's patent, almost a monopoly. The discovery of the Flintshire cannel has altered all this; and although the supply of the coal is, and probably will remain, limited, it has, nevertheless, opened the trade, and so far broken down the monopoly, to the advantage of the trade at large, and also of the public, who are the consumers.

The mineral oils which are obtained, both from the Boghead coal and the Flintshire cannel, are of the kind known as paraffine oils, and differ entirely in their chemical constitution from the oils which are produced by the distillation of common bituminous coal or coal tar. Their leading feature is, that they contain the peculiar crystalline substance, called paraffine, now employed as a substitute for sperm in candle-making, with which they are identical in composition, although differing from it in physical structure.

The manufacture of these oils is now a great established branch of industry, employing large capital and a great amount of business energy.

The discovery of the liquid petroleum of North America had, at one time, apparently placed the trade in the hands of the Americans, but extended experience has shown that the oils can be produced at a cheaper rate from our own coals, provided a supply of the latter, of the proper quality, can be obtained. This problem the discovery of the Flintshire cannel has favourably solved so far; and there can be little doubt that the commercial enterprise which it has directed into the district, will succeed in keeping us independent of foreign supplies, to that extent which is necessary to the maintenance of the trade in a state of wholesome freedom from the trammels which a close market never fails to impose.

Recent Patents.

To Alfred Leighton, *of Buckingham-street, Strand, for improvements in the construction, manufacture, and reproduction of stamps and other printing surfaces in relief.*—[Dated 21st April, 1864.]

This invention has for its object improvements in the construction, manufacture, and reproduction of stamps and other printing surfaces in relief. Stamps to be used by hand for printing letters and words, or it may be designs on papers, packages, and similar articles, are now commonly made with metal printing surfaces fixed to a suitable handle, but such stamps, when used to mark wood or hard substance, produce

very indifferent impressions, unless great care be taken in using them; and if the surface to be printed upon is rough or uneven, the production of a good impression with a metal stamp becomes impossible.

Now this invention consists in manufacturing printing surfaces, whether for stamps or for other arrangements of printing apparatus or machinery, by forming the printing surfaces of india-rubber compound, and vulcanizing them in moulds,—the surfaces printed from in each case being in relief. In order to increase the elasticity, and decrease the liability of the printing surface to spread with the pressure used in printing, the patentee grooves the back of the printing surface or block, or makes elevations and depressions thereon, so that the back of the block may give way or spread with the pressure, and thus relieve and equalise the pressure on the face. The material employed for making the elastic printing surfaces or blocks is india-rubber and sulphur suitable for undergoing the process of vulcanization, and the compound is, as above stated, vulcanized in the moulds used in the process of producing the surface or block. It is preferred, but it is not essential, that no foreign matter other than sulphur should be mixed with the india-rubber, unless it be to color the same.

In manufacturing the elastic printing surfaces and blocks, the patentee employs by preference a metallic or plaster of Paris matrix or mould, into which he presses the compound of india-rubber and sulphur. He then applies at the back of the composition a metal or plaster plate, and presses the same on to the composition, by which means elevations and depressions will be produced to the back of the elastic block, by reason of the plate being formed with parallel and uniform grooves or ridges thereon. Heat is then applied to the moulded mass, whilst still held pressed in the mould, and until the compound becomes vulcanized. The proportion of a suitable compound of india-rubber, and the process of vulcanizing the same, being well understood, it is not necessary to describe them here. The mould usually employed is of metal, and it is by preference obtained from a form of type set up in the ordinary manner. The mould is produced by first obtaining a sunk copy in gutta-percha, wax, or other suitable material. From this copy a copy in relief is obtained in plaster of Paris, and then a sunk matrix in metal, stereotype metal being preferred. From this matrix the vulcanized elastic printing surfaces or blocks are obtained, as already described. In place of a form of type, woodcuts or other surface printing blocks may be used in producing a matrix or mould suitable to be subjected to the heat requisite for the process of vulcanizing.

It will be understood that the elastic printing surface or block produced is, in each case (unless the mould be produced by other means) a reproduction of the printing surface which is employed in making its matrix or mould, having on its back corrugations or undulations.

The elastic blocks having their printing surfaces in relief, when for hand or other stamps, are to be mounted and used in a similar manner to that in which other surface printing blocks have heretofore been used; elastic blocks of larger sizes may be mounted on wooden or other blocks, or on rollers, and may be used in printing machines or presses.

To CHARLES WEIGHTMAN HARRISON, *of Lorimer-road, Walworth, for improvements in looms for weaving.*— [Dated 18th November, 1862.]

THIS invention relates to an arrangement of apparatus for giving the necessary motions to the various moving parts of looms by pneumatic pressure.

In Plate III., fig. 1 represents, in vertical section, the improved atmospheric loom; fig. 2 is a front elevation of the same, showing the shuttle boxes in section; fig. 3 is a detail vertical section of the "pneumatome," or air director or distributor, for working the shuttles; and fig. 4 is a corresponding side elevation of the same. A, is the main framing of the loom, and B, is the sley, which is represented as travelling to and fro in slots C, in the end framing, and supported by anti-friction rollers D, which run along guide rails E, cast on or fitted to the inner sides of the end frames. To the longitudinal centre of this sley, and to the shaft *d*, of the rollers, bands F, F¹, are attached; one of these bands passes over the two guide pulleys *a*, *b*, and is connected at its other end to one end of the piston rod G, which works through both ends of the horizontal air cylinder H, bolted to the loom framing in the longitudinal centre thereof. The air cylinder is supplied with compressed air from any convenient receiver, any well-known arrangement of valves being employed for causing the air to enter each end of the cylinder alternately, and escape therefrom, so as to impart a reciprocating motion to the piston rod. The opposite end of the piston rod is attached to the band F¹, which passes round the guide pulleys *c*, *e*, and *f*, and is connected at its opposite end to the metal eye on the shaft or axis *d*, of the sley beam rollers. On admitting the air to the cylinder, the reciprocating motion of the piston imparts a traversing to-and-fro motion to the sley in its guides through the straps F, and F¹, which alternately pull it in opposite directions, thus producing the "beat-up" of the weft. The heddles I, I¹, are suspended from the pulleys *g*, on the spindle *g*¹, by the straps *h*. The lower portions of the heddles are connected by the straps *h*¹, which pass under corresponding pulleys to those above at *g*; these pulleys, which are not shown, are carried on the shaft *k*. By imparting a reciprocating axial motion to the shaft *k*, the heddles will rise and fall alternately. This reciprocating motion is given to the shaft *k*, by means of the combined guide roller and pulley *e*. Against this pulley *e*, works by frictional contact the strap F¹, so that as the strap moves to and fro, it imparts a rotatory motion, in one direction or the other, to the pulley *e*, thus working the heddles. At each end of the sley beam there is formed a chamber or shuttle box L, closed at the sides but open at each end. Into these boxes the shuttle M, enters and fits accurately without being perfectly air-tight, so that unnecessary friction between the shuttle and its box is avoided. The shuttle race is formed of glass or porcelain, or the shuttle itself is cased therewith. To the outer ends of these chambers are connected the air pipes N, N¹, a portion of such pipes being made either flexible or provided with sliding joints, in order that they may follow the movements of the sley beam. These pipes N, N¹, are connected at their opposite ends to the arms O, O¹; P, is a fixed bracket or support, which carries the pneumatome. Q, Q¹, are two discs, having a series of holes *i*, *i*, made in them near their circumference, and equi-

distant from each other. These discs are fast upon a shaft or spindle R, which rotates in bearings attached to the main framing. The ends of the pipes N, N^1, are in close proximity to the outer faces of the revolving discs, and coincident with the circle of holes *i*; so that as the discs rotate, each hole will, in succession, be brought opposite to the mouth of one or other of the air pipes. S, is an annular air chamber fixed to the bracket P, and against the two opposite sides or faces of this chamber work the discs Q, Q^1, so as to be air-tight. On each side of the chamber is made a single perforation *k*, *k*^{1}, coinciding with the end of the air pipes N, N^1. T, is a pipe, which connects the interior of the air chamber S, with the compressed air receiver. On the shaft R, there is keyed a ratchet wheel U, to which a step-by-step or intermittent rotatory motion is imparted at each forward stroke of the piston in the cylinder by the small pawl *l*, carried on a short cross head, which connects the piston rod with the valve spindle V. The motion is so regulated, that for each tooth the ratchet wheel is rotated, one of the holes *i*, in the disc Q, or Q^1, will be brought opposite the end of the air pipe N, or N^1, and the corresponding hole *k*, or *k*^{1}, in the air chamber, and a jet of air will consequently pass along one or other of the pipes N, N^1, to the shuttle box, and force out the shuttle from that box,—causing it to shoot across the loom and enter the opposite box; from which it is shot back again at the proper time by a jet of air entering that box. In order that the air may enter each shuttle box alternately, the holes I, in one disc Q, are made opposite to the spaces between the holes in the corresponding disc Q^1, in place of making them coincident. By this means, as each movement of the discs is equal to one-half the distance between the centres of the holes *i*, it follows that such holes will be brought alternately in front of the holes *k*, *k*^{1}, in the air chamber; thus allowing the air to pass alternately through the hole *k*, and pipe N, and through the hole *k*^{1}, and pipe N^1, to their respective shuttle boxes.

This part of the invention may be modified in various ways; as, for example, the discs may be stationary whilst the chamber S, revolves; or the two series of holes *i*, *i*, in the two discs may coincide with each other, whilst the holes *k*, *k*^{1}, in the chamber may be placed a little out of line, so that one shall coincide with a hole *i*, in one disc, whilst the other is opposite to the space between the holes in the other disc,—the only object being to direct the air along the pipes N, and N^1, alternately. The take-up motion for the cloth beam is derived from the strap F, which works against a pulley W, and rotates it by frictional contact only. On the axle of this pulley is fitted a pinion X, (shown in dots) which gears into a corresponding toothed wheel Y, on the shaft of the roller or cloth beam Z, and imparts a rotatory motion thereto, for the purpose of winding on the cloth. The pulley W, and pinion X, are connected by a pawl and ratchet wheel, in order that when the pulley is rotated in a reverse or backward direction by the reverse traverse of the strap F, it will be free to rotate without carrying round the pinion, and thus an intermittent rotatory movement will be imparted to the cloth beam. For the purpose of increasing the friction between the strap and the pulley W, a piece of india-rubber is attached to that portion of the strap which is to act upon the pulley.

The patentee claims, "First,—the general construction and arrangement of looms for weaving, as described. Second,—the system or mode of

imparting the requisite movements to the sley beam, heddles, and cloth beam, by means of an air cylinder and piston, in combination with straps and pulleys, substantially as described. Third,—the giving motion to the shuttles of looms for weaving, by the direct action of compressed air, without the intervention of pickers, pistons, or drivers. Fourth,—the peculiar construction and arrangement of valvular apparatus, or pneumatome for directing the air to the shuttle boxes alternately, as described. Fifth,—the application and use to and in the shuttle and ends of the sley beams of looms for weaving of glass, porcelain, and other similar material, to which a smooth or polished surface is given."

To GERMAIN CANOUIL, *of Paris, for an improved alarum and signalling apparatus.*—[Dated 29th January, 1864.]

THIS invention relates, firstly, to certain apparatus which may be applied to a door, window, shutter, or other similar closure, and serve as an alarum, by calling the attention of the people in the room, the house, or others, by the loud report of a detonation taking place at the moment of an undue opening of the closure to which the alarum is applied; and, secondly, to apparatus intended to be applied to railway carriages, and by means of which any passenger within the carriage is enabled to call the attention of the guard or driver, and signal for his aid, by producing a detonation and a strong light or blaze.

In Plate III., fig. 1 shows, in longitudinal section, the alarum apparatus intended to be applied to a door, window, or other similar closure. It consists of a tube A, in which a small plug or hammer *a*, fixed to a rod B, passing through a corresponding hole provided in the centre of the front a^1, of the tube A, is allowed to glide freely, and is acted upon by a spring *b*, coiled round the rod B, in the inside of the tube A; the other end of the rod B, is provided with a button, the part b^1, of which forms a ring. C, is a rod turning at one end on a pin or screw *c*, and provided towards the free end with a stud c^1, in order that when the rod C, is turned, so as to have the stud c^1, applied behind the shoulder b^2, of the button, as in fig. 2, it shall serve as a stop for the rod B. The back end of the tube A, is closed by a cap D, which serves as an anvil for producing the detonation of a fulminating amorce, laid thereon in a depression *d*, when this amorce is struck by the hammer *a*. The cap D, turns as a hinge on a pin *e*, and is provided with a clasp e^1, which, when the cap shuts the tube A, takes round a projecting part e^2, cast on the tube A, which latter is further provided with two wings *f*, for fixing the apparatus against the inner side of the door F, or other closure, by means of the screws f^1; whereas a strong round-headed nail or pin G, is fixed in the door post or frame F^1, at such distance apart from the front end a^1, of the tube A, that when the rod B, is sufficiently far drawn out of the barrel or tube A, the ring b^1, may be put over the pin G; and hereby this pin, and consequently the rod B, and hammer *a*, are kept in the position represented. If now a fulminating amorce be inserted in the depression *d*, of the cap D, and this latter be fixed by the clasp e^1, the apparatus will be ready for serving as an alarum for any person in the room; for should anybody from without open the door, this would cause the alarum to be advanced towards the

inside of the room, whereby the ring b^1, will instantly become released from the pin G, when the spring b, in distending, will drive the hammer a, towards the anvil D, and, by striking the amorce, procure the detonation of this latter, with a loud report, sufficient to awake or call the attention of the person in the room. Should any person, on leaving the room, wish to prevent any person from entering it without his knowledge, after having provided the apparatus with an amorce, and put the rod C, in the position shown, viz., with the stud c^1, behind the shoulder b^2, of the button, in shutting the door behind him the ring b^1, will apply itself over the pin G, and thereby release the button. Should the door now be opened, the explosion of the amorce will take place.

Fig. 2 shows an outside view of another arrangement of alarum, to be fixed against the inside of the frame or door post F^1. A, is a tube or barrel; D, a cap or anvil, kept in position by means of the rods d^1; B, is a rod, provided at one end with the hammer or plug a; whereas to the other or upper end is fixed a catch and springwork, similar to those commonly used for ringing office door bells, and consisting of a fixed part H, and a moveable one I; the part H, being fixed to the rod B, by the shoulder h^1, whilst the opposite end forms a fork h, h, for the shoulder i, of the moveable part I, to turn round a pin i^1, round the lower part of which pin is coiled a spring J, acting from underneath on a gudgeon j, fixed in the part I. The free end of the shoulder i, is arranged in such manner as to allow the part I, to move forward—viz., towards the outside of the door—but not further backward—viz., towards the inside of the room—as to come in the direction of the fixed part H; the free end I^1, of the part I, is rounded off on one side, for allowing the door, in shutting, easily to glide over it. K, is an opening, cut out in a slanting direction in the barrel A, and provided at the top of its side k^1, with a recess for the shoulder h^1, to rest in. By means of the wings f, and the screws f^1, the barrel A, is fixed to the door-post.

The mode of working the apparatus is as follows:—A fulminating amorce having been laid in a suitable recess in the anvil D, or a percussion cap having been placed on a nipple, with which, in such case, the front part of the hammer a, is to be provided, the rod B, is lifted by means of the parts H, I, till the shoulder h^1, rests in the corresponding recess in the top of the front side k^1: by this means the spring coiled round the rod B, in the inside of the barrel A, between the hammer a, and a fixed washer through which the rod B, passes, is contracted. The door, in shutting, will glide over the part I, and pass before it, in which position, should anybody open the door from without, the parts I, and H, would be pushed back, whereby the shoulder h^1, would be lifted out of its rest or recess, and allow the spring to drive the hammer a, downward and strike the amorce on the anvil D.

Fig. 3 shows a side view of another arrangement of alarum, which, in fig. 4, is represented applied to the door post F^1, whilst the door F, is provided with the catch and springwork H, I, described in respect of fig. 2. In figs. 3 and 4, the apparatus is represented in the cocked or armed state, and consists of a solid stay plate L, of the shape shown in fig. 3, to be fixed to the door post F^1, by means of its two wings f, and the screws f^1: in this stay plate L, is provided a slot hole m, for the arm m^1, projecting from the back of the hammer a, to glide in, which hammer is acted upon by the spring M, fixed to the arm m^1, and the

lower part of the stay plate; which spring, in contracting, drives the hammer towards the anvil D, fixed in the stay plate. Towards the top the hammer *a*, has a projecting part or shoulder *n*, which, whilst resting on the top n^1, of the plate L, prevents the hammer *a*, from moving towards the anvil D: a ring n^2, serves for lifting the hammer. In working the apparatus, a fulminating amorce is laid on the anvil D, or a percussion cap is applied on a nipple, with which, in that case, the hammer *a*, is to be provided; this latter is lifted till the shoulder *n*, rests on the top of the stay plate, the apparatus and the catch and springwork H, I, having been applied previously respectively to the door post F^1, and the door F, as shown in fig. 4. On opening the door from without, the catch I, in pushing against the top a^2, of the hammer, viz., in the direction shown by the arrow in fig. 3, will cause the shoulder *n*, to escape from the top of the stay plate L, when the hammer, by the effect of the spring M, will be driven towards the anvil D, and in striking against the fulminating amorce, procure the detonation of this latter, or other fulminating medium made use of.

Fig. 5 represents a longitudinal sectional view of another alarum, intended for railway carriages, and fitted over the seats thereof. It consists of a long tube A, closed at the lower end, and secured to receive at top a tube A^1. In this tube is fixed a central tube R, which is perforated over its entire length with numerous small holes *s*, for transmitting the fire of the gunpowder, with which it is to be filled, to the Greek fire composition to be put in the open space left free between the tubes A^1, and R; whilst round the upper or protruding part of the latter tube is applied a petard or other suitable explosive composition. The centre may further be covered with one or more layers of any suitable waterproof varnish for excluding moisture, and a cap P, may be put over the whole. *a*, is a hammer or plug, fixed to the upper end of the rod B, to the lower end of which is fixed a button Q: the rod B, glides freely through holes, provided for that purpose, in a fixed washer S, in the bottom of the tube A. A spring *b*, is coiled round the same, between the fixed washer S, and hammer *a*; which spring, in distending, will drive this latter towards the anvil D, forming the bottom of the upper tube A^1. The rod B, is represented as partly drawn out of the tube A^1, whereby the spring *b*, will become sufficiently contracted for driving the hammer against the anvil D, and cause the explosion of a fulminating amorce, a percussion cap, or other suitable fulminating medium, applied on the hammer. The tube A, is to be fixed in a corner of the railway carriage to which the apparatus is intended to be applied, and at such height that the tubes A^1, and R, and the cap P, to be applied over these latter, protrudes at the outside of the carriage through a hole in the roof, so as to allow of being easily perceived by the driver or guard of the train. For loading the apparatus—viz., for putting the same in working order ready for immediate use—the upper part, formed by the tubes A^1, and R, is unscrewed from the fixed tube A; the tube R, is filled with gunpowder, whilst a sufficient quantity of Greek fire composition is put in the open space left between the tubes A^1, and R, after which a petard of any suitable composition is applied round the free end of the tube R. The upper part of the apparatus being thus ready, a suitable fulminating medium is applied on the top of the hammer *a*, and the upper part screwed on the top of the fixed tube A, and finally

the cap P, put over the compositions; which, if judged proper, may have been previously covered with one or more coatings of any suitable waterproof varnish, so as entirely to exclude moisture from the explosive or other composition, and keep these latter in perfect working order. The apparatus may now be made use of; and as one of them should preferably be fixed in each of the corners of each carriage of a train, any passenger within will always easily be in reach of one of them, and the signal for aid may at once be given by merely pulling on the button Q, which, on being left free again, will, by the effect of the spring *b*, cause the hammer to strike the anvil D, or bottom part of the tube A¹, with sufficient force to produce the explosion of the fulminating medium; the fire of which explosion will, by means of the holes *r*, perforated for that purpose in the anvil D, and those *s*, of the tube B, be communicated to the gunpowder in this tube and to the petard and Greek fire compositions; the cap P, having been blown off by the explosion of the gunpowder of the tube B.

The patentee claims, "the general arrangement and mode of working of the above-described alarums and railway signalling apparatus, in which, by the effect of a fulminating amorce, or other suitable fulminating medium, a loud report is produced, and, if required, by means of a petard and Greek fire, or other similar detonating or light-producing compositions, a report and light, or blaze, is obtained, sufficient to rouse the attention of the guard of the train on which the apparatus is made use of, and this as well by daylight as during night."

To RICHARD HENRY NAPIER, *of Southampton-street, Strand, for improvements in the construction of screw steamers for naval warfare.*—[Dated 8th February, 1864.]

THIS invention consists in constructing flat-bottomed screw steamers, so that guns of heavy calibre can be worked with a lighter draught of water than can be otherwise conveniently attained. The vessels are constructed with lateral projections or bulges in their top sides, and a sudden increase of beam is given, extending for about twenty-one feet, before and abaft the centre, and terminating obliquely, to present an angular surface, to cause shot which may strike it to glance off. A gun platform is thus formed in the midship part of the vessel, from which a cross fire could be obtained at thirty feet ahead and astern, and by which the weights are thrown to or towards the centre instead of the ends of the vessel. An elliptical roofing, covered with iron or steel, is made, to protect the crew while fighting their guns on the platform, and the guns are worked on tramways, so that they may be the more easily handled.

In Plate IV., fig. 1 represents a side elevation or broadside view of a screw steamer adapted for naval warfare, constructed according to this invention; and fig. 2 represents a plan or deck view of the vessel. *a*, is the midship part of the vessel; *b*, an elliptical-shaped roofing or cupola, covered with iron or steel, and intended to protect the crew while fighting their guns; *c*, *c*, are tramways fixed to the platform on which the guns *d*, are placed; *e*, are port-holes through which the

muzzles of the guns are caused to protrude, as represented at fig. 2; *g*, is the rudder; and *h*, the screw for propelling the vessel, the said screw being fixed on a shaft, worked by a steam engine in the usual way. Thus four guns can be directed either ahead or astern of the vessel, to be used either in pursuit or in retreating.

The patentee claims, "the combinations and arrangements described in the construction of screw steamers for naval warfare."

To Frederick Alexander Preston Pigou, *of Throgmorton-street, City, for improvements in the construction of powder flasks.*—[Dated 12th April, 1864.]

This invention consists in regulating the supply of gunpowder to the nozzles of powder-flasks, by means of a slide, preferably of metal, which is placed immediately beneath the circular plate which forms the head or top of the flask. This slide has formed in it an opening corresponding to the aperture in the plate over which the nozzle is fixed. A shank, terminated in a button, projects through the side of the flask, for the purpose of acting on the slide when wished, and has formed on it a stud or projection, against which a spring presses.

In Plate IV., fig. 1 is a plan of the improved powder flask, open, and fig. 2 is a section, showing the interior of the flask and the guide in which the slide moves. *a*, is the flask; *b*, the nozzle, at the bottom of which, and under the plate *c*, is placed the slide or disc *d*, in which is formed the opening d^1. The shank *e*, projects through the side of the flask, and terminates in a button *f*. The spring *g*, is fixed to the nozzle *b*, as shown, and presses against the projection *h*, which forms part of the shank *e*. The action is as follows:—On pressure being applied to the button *f*, the resistance of the spring *g*, is overcome, and the slide is moved so as to bring the aperture or opening d^1, under the hole in the plate *c*, at the bottom of the nozzle *b*. On the removal of the pressure, the spring *g*, brings back the slide or cover to its normal position, thereby closing the flask.

The patentee claims, "The application and use of a disc or cover placed in the necks of powder flasks, for the purpose of measuring the charge, to be actuated by means of a spring, of the shape, and having the arrangement of parts and action, as described."

To Henry Smith *and* Edward Roberts, *both of Widnes Dock, near Warrington, Lancashire, for improvements in machinery for breaking stones and minerals* —[Dated 29th March, 1864.]

This invention consists in acting upon stone or mineral, by means of lever jaws, for the purpose of breaking them.

In Plate IV., fig. 1 shows, in side view, and fig. 2 in plan view, a machine constructed according to this invention. *a*, is a fixed jaw, and *b*, a moveable jaw, between which the stone to be crushed is fed. The jaw *b*, is formed at the outer end of a lever *c*, which turns on an axis at *d*, supported by the two side plates or frames *e*, of the machine. The fixed jaw *a*, is also supported by these side plates, and is supported in

such manner that it can be set nearer to, or further from, the moveable jaw. For this purpose it is supported by a pin *f*, near its upper end, and at its lower end a slot is formed through it, through which wedges, or filling pieces, may be passed; the ends of the wedges being received in slots in the side plates or frames *e*. By changing these wedges, the distance between the fixed and moveable jaw can be varied. The working faces of the jaws are faced with steel plates, *g*, *g*, which are inserted into dovetail grooves therein, so that they may be renewed when worn away; the acting surfaces of these plates may be either plain or corrugated to sharp angles, in any suitable direction. The end of the lever *c*, is connected by a rod *h*, to the crank *i*, of the shaft *k*. This shaft carries two fly wheels *l*, *l*, and also a driving pulley *m*, by which motion is imparted to it. In order to afford a further means of varying the gauge to which the stones or minerals are broken, the connecting rod *h*, may have a number of holes at its lower end, where it is attached to the lever *c*, so that the point at which the end of the lever *c*, is connected to the rod may be varied, and the end of the lever *c*, thereby raised or lowered, so varying the opening between the fixed and moveable jaws. It will be seen from fig. 1, that the lower parts of the jaws that are below the axis of the lever *c*, are set to come closer together than the upper parts of the jaws that are above the axis; the stone will thus be twice acted on by the jaws for every revolution of the shaft *k*. The stone to be broken is introduced at *n*, and as the upper parts of these jaws approach each other, the stone between them is partially crushed. When the upper end of the jaw *b*, recedes from the fixed jaw *a*, the lower end of the moveable jaw approaches towards it, and further crushes the stone that has been partially crushed by the upper parts of the jaws.

To JOHN STRAFFORD, *of Stratford, Essex, for improvements in roof lamps of railway and other carriages.*—[Dated 23rd March, 1864.]

THIS invention relates, first, to holding a glass in position by elastic pressure; and, secondly, to means of controlling the passage of the air admitted into the lamp, for the purpose of supporting combustion and for keeping the oil cool.

The figure in Plate III. shows a section of a roof-lamp, with the improvements applied thereto. *a*, *a*, is the outer case or frame of the lamp; *b*, is the glass, having a flange, b^1, which, when the glass is passed downwards, through the inner case *a*, rests on the rim a^1, of that case, but, with india-rubber, *c*, interposed, at intervals, to prevent injury to the glass, and to allow of its expansion and contraction, as well as to obtain a firmer hold of it. These pieces of india-rubber *c*, are attached to, and hang from, the metallic springs *d*, the lower ends of which have applied to them other pieces of india-rubber d^1, adapted to come over and rest upon the glass rim, to prevent it from being pushed upwards, out of its place, from the under side, when in use, whilst they admit of the glass being removed and replaced, when those springs are acted upon by pressure on them, from the inside of the case. The springs *d*, are applied to the inner case a^2, of the lamp. Air, from the exterior of the lamp, in passing into the interior thereof, to

support combustion and keep the oil cool, passes first under the screen *f*, thence through a series of smaller holes *g*, to the annular space between the outer case *a*, and the inner case a^2, and this space is provided with horizontal partitions a^3, serving to divert the air, and prevent it from passing too freely direct to the interior of the lamp. The air passes these partitions at the spaces between them a^4, a^4, a^4, and thence from the lower part of this space between the outer case *a*, and the inner case a^2, it passes by the openings a^5, formed in the inner case a^2, to admit of the free action of the springs *d*. The air thence passes partly downwards to the flame, without causing flickering, and partly through the long vertical slits or openings *h*, between the reflector *i*, the chimney *j*, and the oil vessel *e*, with a tendency to keep the oil vessel cool. In order to obtain increase of reflecting power, the under side of the metal rim a^1, is silvered or enamelled.

The patentee claims, "First,—the holding the glasses of roof lamps of railway and other carriages by elastic pressure, substantially as explained. Secondly,—the means of controlling the passage of the air to the interior of the lamp, so as to prevent flickering of the light, and keep the oil in the oil vessel cool, as explained. Also,—the application of the rim a^1, for strengthening the lower edge of the case of the lamp, and, by its being silvered or enamelled, of obtaining increased reflecting power, as explained."

To ELIJAH STOTT, *of Monks Coppenhall, Cheshire, for improvements in the manufacture of rails for railways; which improvements may also be applied to the manufacture of bars for the tyres of railway wheels, and for other purposes to which the said bars are or may be applicable.* —[Dated 1st April, 1864.]

THIS invention consists in making steel-faced rails for railways, which improvements may also be applied to the manufacture of steel-faced bars for the tyres of railway wheels, and for various other purposes.

In Plate III., fig. 1 represents in section a compound bar or slab of wrought or puddled iron and steel, to be used in carrying out this invention. This compound bar or slab consists of a bar or slab of wrought or puddled iron *a*, and a slab or bar of steel *b*. The slab *a*, has a groove or trough *c*, made in one of its faces, running along its whole length, to receive the bar of steel *b*. In making a rail or bar with only one steel-faced surface, according to this invention, the compound bar or slab, fig. 1, forms the bottom or top of the pile, the steel face of the bar or slab being turned outwards. Upon the compound slab *a*, *b*, old rails are piled, as commonly practised in piling iron; the depressions between the flanges of the rails at top and bottom being filled up by properly shaped bars. The pile, with or without a slab of wrought or puddled iron on its top, is raised to a welding heat, and welded by rolling into a compact mass or bloom, which is afterwards re-heated, and drawn out by rolling or hammering into rails or bars of the required size and shape. When the rail or bar is required to have two steel-faced surfaces, the pile is made with two of the compound slabs, fig. 1,—one being placed at the top, and the other at the bottom, of the pile; the steel face in each of the slabs being outwards. Instead of making the sides of the trough in the iron slab *a*, at right angles to

the bottom of the bar, as in fig. 1, they may be inclined or be made of a dovetail figure, the steel bar having a corresponding shape to fit the dovetail groove. The making up of the compound slab may also be effected in the manner represented in section in fig. 2, that is to say, instead of taking a slab of iron with a groove or trough in it, as before described, a plain bar of wrought or puddled iron *f*, is used; the bar being of greater width than the steel bar *g*, employed: and on either side of the steel bar *g*, are placed narrow bars of wrought or puddled iron *h*, *h*, the outer sides of the narrow bars *h*, being flush with the sides of the plain bar of iron *f*. The parts *f*, *g*, *h*, are raised to a welding heat and welded together before being used, to form the top or bottom, or top and bottom, of the pile; or they may be used in the pile in the positions represented, without being welded together. In order to make the steel bar engage more firmly with the iron slab by which it is surrounded on three sides, the steel bar may have a rib running along its under side, which rib is made to engage in a groove in the iron slab, within that in which the greater part of the steel slab fits. This arrangement of the compound slab is represented in section in fig. 3, *i*, being the steel, and *k*, the wrought iron. In making compound slabs which are to be used in a pile, in which old rails or railway bars are employed, it is preferred to give that face of the compound slab which is situated outwards in the pile such a figure that it will fit in the depressions between the flanges of the rails or bars. In this case it is also preferred to make the iron bar or slab in two pieces, the bar of steel fitting between the said iron pieces. Fig. 4 represents in section a compound bar or slab of the last described kind; *l*, *m*, are the two iron bars between which the steel *n*, is situated, and fits in the manner represented. The under side l^2, m^2, of the bars *l*, *m*, is so shaped, that it fits into, and fills up, the depression between the flanges of the rails. By giving the parts l^2, m^2, of the bars *l*, *m*, the form represented, no filling-in pieces are required, as when the inner face of the compound bar or slab is flat. By making compound bars or slabs of which the top or bottom, or top and bottom, of the pile are made, in the several ways described and represented, the edges of the steel bars are effectually covered by the iron portion of the compound bar or slab, and thereby preserved from the injurious action of the fire during the heating of the pile, and a sound welding of the steel to the iron is produced by the action of the rolls. The bars or slabs of iron and steel, of which the compound bars or slabs are composed, are made by rolling them in properly-grooved rolls.

The patentee claims,—"the improvements in the manufacture of steel-faced rails for railways, and steel-faced bars for the tyres of railway wheels, and for other purposes to which the said bars are or may be applicable, hereinbefore described,—that is to say, making the top or bottom, or top and bottom, of the pile from which the said rails or bars are to be made, of a compound bar or slab of iron and steel; the edges of the slab or bar of steel of the said compound bar or slab being covered and protected essentially in the several ways described and illustrated, so as thereby to preserve the said edges of the steel bar or slab from the injurious action of the fire during the heating of the pile, and ensure a sound welding of the said steel to the iron.

To EDWARD LINDNER, *of New York, U. S. A., for improvements in springs applicable for railway carriages, buffers, and other similar purposes.*—[Dated 2nd April, 1864.]

THIS invention mainly consists in surrounding metal springs by a liquid enclosed in a box or chamber, in which the springs act. As the liquid always exercises an equal pressure upon the spring, and as every part of the spring is surrounded by the liquid, all vibration of the spring is obviated. Into the liquid contained in the box or chamber is introduced one or more bags or cases of india-rubber filled with air; or a moveable piston may be put into such chamber, in order that the spring may be free to move therein. The spring and the air act together, that is to say, the air, by being compressed, greatly increases the spring power of the apparatus. To prevent the liquid escaping from the box when pressure is exerted on the spring, thick liquid is employed; and the closing is made hermetic by the pressure from within.

In Plate III., figs. 1 and 2 are longitudinal sectional views of springs constructed according to this invention, suitable for the buffers of railway engines and carriages, for the reception of the recoil of cannon, and for other similar purposes. The arrangement shown in fig. 3 is suitable for being placed under the bed of a carriage.

A, fig. 1, is an iron box or framing of the spring; the inner space H, H, is rendered air-tight by the cover B, and by india-rubber packing F. D, is the piston, tightened from without by the stuffing box E, and its packing e^1, and from within by the india-rubber disc F. In the lower space is a hollow india-rubber ring or cushion G^1, the air in which is used as a resisting medium. Upon the inner end of the piston D, there are two metal discs i, i^1, with perforations through them, to allow a free passage of the liquid with which the box is filled. The liquid is inserted through a hole provided with a screw thread on one side, and is kept tight through the packing e^1, but chiefly by the india-rubber disc F, which, being fastened to the cover B, gives way to the inward pressure of the liquid; and the greater the pressure, the tighter the joint. Between the two discs i, and i^1, there is a spiral spring K, K, which retains the piston in position. The action of this spring is as follows:—On pressure being applied to the piston, it is driven into the space H, taking with it the disc i, by means of its shoulder L; and consequently the spring K, K, resting upon the disc i^1, offers resistance to the piston. The spring, at the moment of compression, is pressed and supported in all its parts by the compressed liquid in the box. The liquid in the box receives an equal elastic pressure from the compressed air in the hollow india-rubber ring or cushion G^1. On pressure being removed from the piston, the force of the compressed air within the cushion G^1, and the power of the spring, will bring the piston into its normal position.

Fig. 2 represents a spring somewhat modified in its details from that last described. Here the spring E^1, is of a different form. The spaces between the different coils are sufficient to allow of the circulation of the liquid, and by that means cause an equal strain upon the spring. The cushion G^{11}, is of spherical form. The piston N, is applicable where the pressure to be resisted is very great, in consequence of its large inner surface Q, compressing, by means of the liquid, the air more

suddenly in the cushion G^{11}. The piston N, has a channel *e*, bored through it, to allow of the space H, being refilled with liquid, in case the liquid should, in the course of time, have diminished: the channel is closed tight by a packing screw. A stuffing box S, with its packing S^{11}, surrounds the upper part of the piston N.

The patentee shows another arrangement, in which the air is confined in an air-tight compartment made of thin sheet-iron. A coiled spring touches the cover of the air-tight compartment, and offers resistance to the pressure of the liquid upon the cover, and thereby also to the outer pressure of the piston; and at the same time brings back into its former position the air-tight compartment, after the pressure is withdrawn. The spiral spring is of the same kind as in fig. 2, and rests upon a disc, which has openings to allow the liquid to circulate, in order to impart the received pressure to the air in the compartment.

Fig. 3 represents, in longitudinal section, an elastic resisting apparatus for use between the bed and upper frame of a railway carriage. Q^1, is a forged iron piece, brought into fixed connection by screws and shoulders, with the bed D^1. The spiral spring, which rests upon the shoulders K, K^1, of the apparatus, supports partly the piston F, and the pressure of the upper frame of the carriage, which rests upon it. N, is an india-rubber ring or disc, and o^1, an iron ring or disc, which form a packing for the lower end of the piston. The remainder of the space of the apparatus has small india-rubber air balls h^1, and is filled with a liquid which circulates freely through and into the chambers. M^1, M^1, are screw stoppers. On pressure being applied to the piston F, the same actions take place as are described with reference to the other figures. The perforated iron discs i^1, i^1, are only intended to retain the india-rubber balls h^1, in their proper places. The liquid used is molasses with dissolved glue, which is found to preserve the india-rubber, and is not liable to freeze.

The patentee claims, "constructing springs applicable for railway carriages, buffers, and other similar purposes, by using liquid enclosed in a box or chamber, and placing within the said box or chamber one or more air bags or cases, with or without a metal spring acting in said box or chamber, as described."

To ERNEST ULYSSE PAROD, *of Paris, for improvements in feeding steam generators, applicable also to the condensation of steam and the production of vacuum.*—[Dated 2nd April, 1864.]

THIS invention consists in the employment of a jet of water under pressure, in such a manner as to induce along with the jet a current of gas or steam, thereby effecting the condensation of the escape steam of steam engines and the production of a vacuum; whilst at the same time, as the jet of water which serves to induce the current of gas or steam possesses a high velocity and considerable momentum, it is proposed to utilize its momentum by causing it, in company with the condensed steam, to penetrate into the steam generator, thus producing a novel system of feeding steam generators.

In Plate III., fig. 1 represents a vertical section of one form of the improved apparatus. Water is forced into the air vessel A, through

the aperture B, by means of any suitable pump, or by the aid of material or artificial pressure. C, is a retaining valve fitted inside the passage or pipe D, which leads from the interior of the air vessel; the spring of this valve being sufficiently powerful to prevent the valve from opening until the desired pressure is obtained in the vessel. The air which is confined in the upper part E, of the vessel, serves as a pressure regulator. F, is a stop valve, for starting and stopping the working of the apparatus. A pressure gauge should be fitted to the vessel A, in order to show the degree of pressure therein, and a water gauge should also be provided, to indicate the level of the water in such vessel. The water which escapes by the valve C, passes through one or more nozzles G, of any suitable form, and flows into and through the funnel-shaped opening H, the orifice of which should have the same form in transverse section as that of the jet nozzle G, but rather larger. The powerful jet of water, thus obtained, will draw along with it the steam which arrives by the escape or eduction pipe I, of a steam engine, and will carry it downwards to the base of the funnel mouth, where the steam will become intimately mixed with the water on passing through the contracted orifice K, which, as before stated, is slightly larger than that of the jet nozzle. Beneath the orifice K, a conical pipe L, may be made to communicate with the inlet valve box M, of a suction and force pump N, of any suitable construction. This pump (of a capacity greater than the volume of water discharged during one stroke of the piston by the jet under the pressure of the air vessel) will exert a powerful sucking action, which will augment the motive power of the jet, and at the same time will prevent any choking action which might occur at the base of the funnel mouth. So soon as the piston of this pump has completed its suction stroke, it will, on its return stroke, force the water and condensed steam (previously drawn in through the clack O,) through the lower clack P, and pipe Q, into the boiler, or into a reservoir or tank, according to the level of the water in the boiler. For this purpose, a cock R, is fitted on to the pipe Q, leading from the force pump to the boiler, which cock, when open, allows the water and condensed steam to be discharged into a tank or reservoir. In this case, the retaining valve S, in the boiler is closed by the pressure of the steam therein, and the whole of the water discharged by the pump flows into the tank; whence it is again drawn up by the force pump connected at B, to the air vessel, and made to pass again through the apparatus, as before described, to be re-discharged into the tank or directed into the boiler, as the case may be. When it is necessary to feed the boiler, the cock R, is to be closed, and the jet of water and condensed steam will then be directed into the boiler, opening the valve S, in its passage. The jet may, if preferred, be directed into the boiler or tank without the intervention of the suction and force pump; it being simply necessary to impart sufficient force to the jet or jets, to overcome the pressure in the boiler: for which purpose an excess of pressure in the air vessel A, should be constantly maintained. When the feed is supplied to the boiler direct, an intermediate pipe Q^1, may be employed, similar to that shown in fig. 2, which is provided with an ordinary cock and a retaining valve, or with a three-way cock R^1, as shown, with or without the retaining valve, fitted in the branch pipe leading to the boiler.

Fig. 3 is a sectional view of a slightly-modified arrangement of appa-

ratus constructed on precisely the same principle as that shown in fig. 1, but having a tubular jet, so as to utilize both the interior and exterior of the jet in inducing and condensing the escape steam. According to this modification, the steam arrives simultaneously by the pipes I, I¹; and the lid or cover T, of the chamber U, has an internal tubular projection or nozzle V, formed thereon, corresponding with the straight portion of the pipe I,—such internal projecting nozzle entering the jet nozzle G, and terminating flush therewith at its lower extremity, as shown. An annular space is left between the exterior of the projecting nozzle V, and the interior of the jet nozzle G, through which annular space or opening flows, in the form of a tubular or hollow jet, the water which is forced from the receiver or air vessel through the pipe D. This tubular jet directed towards the bottom of the funnel mouth H, passes between the sides thereof and the external surface of the cone W, the axis of which coincides exactly with that of the jet pipes above. To the under side of the sole plate X, X, of this cone is fixed the pipe L, which may either lead to the valve box of a suction and force pump, as illustrated at fig. 1, or may pass direct to the boiler without the intervention of the pump. The steam which enters by the pipe I¹, is carried along by the friction of the inner sides of the jet against the inclined surface of the cone W, as far as the bottom of the funnel mouth; whilst the steam which arrives by the pipe I, round the exterior of the jet is carried along by the friction of the external portion of the jet against the inner sides of the funnel mouth H; the whole operating exactly in the manner herein-before described.

The patentee claims, "First,—the general construction and arrangement of apparatus for feeding steam generators, condensing steam, and producing a vacuum, separately or together, by the aid of a jet or jets of water, substantially as described. Second,—the system or mode of condensing steam and feeding steam boilers, by the inductive power of a jet or jets of water, obtained in the manner described."

To JACOB BAYNES THOMPSON, *of Rothwell-street, Regent's-park-road, for improvements in electro-magnetic induction machines.*— [Dated 9th April, 1864.]

THIS invention has for its object the so arranging electro-magnetic induction machines as to make them suitable for use for ordinary telegraphic purposes—the machine itself making and breaking the primary battery circuit, and also working a commutator, so as to lead all the positive induced currents to one conducting wire or channel, and all the negative induced currents to another conducting wire or channel: hence, when these wires or channels are connected at a distance, a current, which is practically continuous, flows through them: and this current may be used for telegraphic purposes, just as a direct battery current is now commonly used.

Two sets of induction coils are employed, arranged end to end, and at a short distance apart; and in each set, by preference, there are two or an even number of coils. When two coils are used in each set, their soft iron cores are connected together at their outer ends by a permanent armature; and when more are used, their cores are coupled together in pairs

by permanent armatures. Between the two sets of coils an oscillating armature is arranged, which, by a rod connected with it, or otherwise, is made, as it moves to and fro, to send the primary current first into the primary wires of one set of induction coils, and then into the primary wires of the other set of coils. The oscillating armature also moves the commutator, by which the currents induced in the secondary wire of the induction coils, which are reversed by changing the primary current from one set of coils to the other, are nevertheless caused to pass from the machine always in the same direction; the contacts being changed by the commutator, to compensate for the changes in the direction of the induced currents. Thus both the primary and secondary currents are directed by the machine itself, so that the machine is self-acting; for as soon as the primary current is allowed to flow, one set of induction coils is thereby magnetized, and the oscillating armature is drawn towards this set; then, as this motion cuts off the primary current from the first set of coils, and turns it over to the other set, these in turn draw back the oscillating armature, which is thus kept in constant motion so long as the primary current is on. Similarly, the proper directing of the induced current is effected by the machine itself, the commutator being moved by the oscillating armature every time the primary current is directed from one set of coils to the other. This self-action of the machine is an important feature of the invention.

In Plate IV., fig. 1 is a plan, and fig. 2 an end view, of an electro-magnetic induction machine, constructed according to this invention. *a*, *a*, is the base plate of the machine, and *b*, *b*, and *c*, *c*, are two sets of induction coils. There are in this machine two coils in each set. b^1, and c^1, are permanent armatures, connecting together the cores of each set; *d*, is an armature, which, when the machine is at work, oscillates between the poles of the two sets of coils. This armature *d*, is fixed upon a rod *e*, passing through holes bored for it in the fixed armatures b^1, and c^1, so that these armatures form guides for the rod as it moves endwise with the armature *d*; the armature *d*, is also perforated at its ends, and brass or gun-metal guides *f*, *f*, pass through the holes, and the armature is thus kept truly opposite the poles of the coils. *g*, *g*, are spiral springs, tending to bring the armature *d*, to a central position when the machine is at rest. At one end of the rod *e*, is an apparatus for alternately throwing the battery current from one pair of coils to the other. This apparatus consists of a metal quadrant *h*, carried by an axis *i*, which turns freely between fulcrum points *k*, *k*. h^1, h^1, are contact pieces, fixed in the quadrant *h*, and capable of being readily changed should they wear; h^2, is a shunt tooth, cut in the quadrant; and h^3, h^3, are springs fixed to the quadrant, and acting with the shunt tooth h^2, and another shunt tooth on the rod *e*, to give firmer contact on the instant of changing; but the commutator will work without them, though not so rapidly.

Fig. 3 is a side view of the rod *e*, and shunt tooth e^1. This tooth, as the rod *e*, moves longitudinally, comes against the tooth h^2, and moves it with the quadrant *h*, which carries it sideways, thus forcing one of the contact pieces h^1, down into contact with the spring anvil *l*, beneath it. The tooth e^1, in sliding past the tooth h^2, comes against one of the springs h^3, which yields, to let it pass; and immediately it has passed

the tooth h^2, the spring throws the quadrant h, over. The contact piece h^1, which has just been pressed down on its anvil l, is thrown off it whilst contact is being made on the other side. As the rod e, and tooth e^1, return, the tooth acts on the other side of the tooth h^2, and moves the quadrant further over,—maintaining the contact between the other contact piece h^1, and anvil l, until the teeth have again passed each other; thus the two teeth revolve round each other. It will be seen that the spring anvils are arranged to yield to the pressure of the contact pieces, and then, as the contact pieces recede, to follow it until they are stopped by the adjustable buttons m, m. Short pieces m^1, m^1, of india-rubber tubing are introduced between the anvil spring and the button, to prevent noise. At the other extremity of the rod e, is a cross head n, at each end of which a cylindrical hole is bored; and this is lined with a tube of glass, or other insulating material, cemented into it. o, o, are metal stems or contact cores, fitted into the cross head: these are passed through the glass-lined holes, and are fixed, by means of a head or flange, on the stem coming on one side of the cross head, and a nut screwed on to the stem on the other side. Washers of gutta-percha prevent metallic contact between the stems o, o, and the cross head. The stems o, o, are furnished with glass tips o^1, o^1, and are passed through holes, bored to fit them, in the brass or gunmetal induction ports p^1, p^2, p^3, and p^4. Thus it will be seen that, when the rod e, is at either extremity of its course, the contact cores o, will at that end lie in metallic contact with the ports p, having entered into the holes in them; whilst, at the other end, there will be no metallic contact between the contact cores o, and the ports, as the glass tips o^1, will only enter the holes in the ports. When the rod e^1, is moved from end to end of its course, the metallic contacts are broken at one end of the contact cores o, and then made at the other end. Each of the ports is bored with a small hole p^*, into which a drop of mercury is placed, to ensure a perfect contact, and the ports which come together are amalgamated. q, q, are wires, connected with the contact cores o, and coupling them with the binding screws r, r. s, s, are other binding screws in connection with the secondary wires of the induction coils. t, t, are condensers, each consisting of two sheets of tin-foil, sixteen feet long, the surfaces of which are, throughout their whole length, placed as close together as is consistent with their perfect insulation from each other by means of sheet gutta-percha, or otherwise. This being the general construction of the instrument, one of the poles of the galvanic battery is, as shown by the diagram, fig. 4, connected directly to one end of the primary wire of each set of induction coils, and the other ends of the primary wires are connected respectively to the spring anvils l, l; the other pole of the battery is connected with the quadrant h, and its contact pieces h^1, so that as the quadrant rocks, as already described, the primary current is directed alternately to one and the other of the two sets of induction coils. One of the strips of foil also in each of the condensers t, t, is connected directly to one pole of the battery, whilst the other strips are connected respectively with the spring anvils l. The condensers serve to lessen the spark which passes each time the contact pieces h^1, come down on to the anvils l. The two sets of induction coils are arranged in such manner that the similar poles come opposite to each other, so that each pair may assist

in demagnetizing the other, which the electricity has just left; besides, by this means, the making induced current in one pair of coils, and the breaking induced current in the other, are caused to flow in one and the same direction; consequently the secondary wires are enabled to pass continuously around all the coils. These are connected respectively to the two ports p^1, p^2, and these are connected diagonally to the ports p^3, p^4; so that it will be seen that the motion of the rod e, constantly reverses the connections between the ends of the secondary wires and the binding screws s, s; and it is from these binding screws that currents for telegraphic or other purposes are taken. The reversal of the connections of the binding screws s, s, with the secondary wire takes place, as will be observed, when the rod e, is at mid-stroke or thereabout, and the reversal of the battery connections with the primary wires takes place near the end of the stroke of the rod e; so that when the latter reversal takes place, there is always metallic connections for the free flow of the induced currents produced at the commutator to the binding screws s, s, and so to the telegraphic wires or other conductors. In order to prevent the oscillating armature d, actually striking the poles of the coils, vulcanized india-rubber buffers are employed. These are pieces of vulcanized rubber, having inclined slits in them, the sides of which are bevilled; and between the two sides the rod e, passes. The india-rubber can be raised or lowered by the adjusting screws, and in this way the stroke of the armature may be regulated, so that it may come close up to the poles without actually striking them. By raising the india-rubber buffers, the wider parts of the slits are brought opposite the poles, and then the armature can approach closer than when, by lowering the buffer pieces, the narrower parts of the slits are brought opposite to the poles. The instrument represented is adapted to work through two hundred miles of an ordinary telegraphic line, or to do about the same work as fifty new cells of Daniell's battery, such as are commonly employed in working telegraphs. The cores of the coils are, in this case, formed of bundles of soft iron rods, three-sixteenths of an inch in diameter, and the bundles are one inch and a quarter in diameter. They are each made in two parts, being divided in the centre of their length, and a disc of cardboard is introduced between the two parts. In a machine designed to supply electricity of high tension, the cores should not be divided, but made each in one bundle. Around each of the cores there is a primary or battery coil, consisting of three layers of No. 12 copper wire, covered with silk or cotton; and over this again is the secondary coil, consisting of 320 yards of covered copper wire, No. 18; and, in making up the coils, the layers are separated with a thickness of paper — the layers having been first covered with a paste made of bees'-wax and turpentine—the paste filling all the interstices in the layers. The machine can be worked efficiently with three cells of Daniell's battery, with plates exposing a surface of sixteen square inches. If it be desired to reduce the intensity and increase the quantity of the induced current, it may readily be done by coupling the secondary coils each separately with the ports p^1, p^2, in place of coupling them in series, as is shown; or, if desired, they may be coupled to the ports in pairs. In constructing machines to give greater intensity of current, the length of the secondary coils is increased, and the size of the wire employed diminished. Or, if very great intensity

is required, the armature *d*, is made an electro-magnet, by surrounding it with battery coils; and, in this case, in place of arranging the battery commutator to make and break the battery circuit in the induction coils, it is arranged simply to reverse the current at each motion, so that each coil may alternately attract and repel the electro-magnetic armature.

To HENRY BERNOULLI BARLOW, *of Manchester, for certain improvements in the slide valves of steam engines,—being a communication.*—[Dated 16th April, 1864.]

THIS invention consists in so constructing slide valves that, with the ordinary valve motion of a single excentric or tappet, and one valve spindle, the steam may be cut off at various parts of the stroke without interfering with the exhaust passages.

In Plate IV., fig. 1 is a longitudinal section of part of the cylinder of a steam engine to which the improved slide valve is applied. *a*, is part of the cylinder, which is constructed in the usual manner, with ingress and egress ports and passages *b*, and *c*, and with the exhaust port *d*; *e*, is the slide valve, in which are the passages b^1, c^1, and d^1, for the admission and escape of the steam. The valve slides between shoulders in the valve chest, and above it is the moveable plate *f*, with the two ports b^2, and c^2. The valve rod or spindle *g*, is attached to the bridle *h*, which surrounds the plate *f*, and is of sufficient width to pass partly over the ends of the slide valves *e*. The valve spindle *g*, passes, as usual, through a stuffing box at the end of the valve chest, and it is worked by an excentric or tappet, the throw of which is equal to the traverse of the valve *e*, and the traverse of the moveable plate *f*. The moveable plate and the slide valve are shown in the positions they occupy when they have been moved to the full extent in the direction of the arrow, and the ports are full open, to admit steam through the passages c^2, c^1, and *c*, to the right hand end of the cylinder: at this time the exhaust port *d*, is full open for the escape of the steam to the off pipe or condenser. At the return stroke of the excentric or tappet, the plate *f*, moves in the contrary direction of the arrow, and first shuts off the steam from the passages c^1, and *c*,—the exhaust passage b^1, and port *d*, remaining full open for the discharge of the exhaust steam, until the bridle *h*, comes in contact with the end of the slide valve: at this time the port b^2, is over the passage b^1, and, from this time, the bridle, acting on the slide valve and moveable plate, causes them both to move until the end of the passage b^1, comes over the passage *b*, to admit steam to the other end of the cylinder, and the passage *c*, is open to the exhaust port *d*. The ports are shown of the requisite width for cutting off the steam at two-thirds of the stroke; the point of cut off can be varied to any extent between these two limits, by varying the widths of the ports in the plate *f*.

Fig. 2 is a longitudinal section of a modification of this invention. In this arrangement the side passages for the steam *b*, and *c*, are much shorter than usual, to economise steam; and there are two exhaust ports *d*, which may be connected to a branch pipe. The moveable plate *f*, is cast with flanges, to act alternately on the ends of the slide

valves *e*. The mode of operation is precisely similar to that above described in reference to fig 1.

Fig. 3 represents a mode of applying the variable expansion to the improved slide valve. The moveable plate *f*, in this arrangement, is made with wide ports b^2, and e^2; and within these ports are the two back plates *i*, *i*, which are connected by the right and left hand screws *j*, *j*, forming part of the spindle *k*; this spindle is supported by the bracket f^1, projecting from the plate *f*, and the other end passes through a stuffing box in the side of the steam chest, and is provided with a hand wheel. By turning this wheel round by hand, or connecting the spindle *k*, to the governor or other self-regulating apparatus, the back plates *i*, are made to approach, or recede from, each other—thus regulating the cut off to the extent required.

The patentee claims, "the application of a moveable plate with ports to the slide valve of a steam engine, and giving motion to the same, in the manner described. Also the modification, shown in fig. 3, for varying the cut off of the steam."

To JOSEPH STANDEVEN, *of Saddleworth, Yorkshire, for improvements in self-acting mules for spinning and doubling.*—[Dated 21st April, 1864.]

THIS invention relates to the apparatus employed in self-acting mules for regulating the winding of the yarn on to the spindles, at a proper tension. In this apparatus it has been usual to employ a lever, which, at intervals, is acted upon, and which in turn acts upon other apparatus, to turn the screw in the quadrant, which turning of the screw slides the nut on it towards the circumference of the quadrant, and thereby varies the situation of the point of attachment of the winding-on chain. The above lever is usually supported by a chain or cord, one end of which is attached to, or connected with, a finger on the counterfaller shaft, and the other end is attached to a finger on the faller shaft; the chain passing under a pulley or bowl connected with the lever; in which case the position of the lever is governed by the joint motion of the faller and the counterfaller. In other arrangements, the chain, after being connected with the counterfaller, is, at the other end, connected with the lever, without passing to the faller; in which case the position of the lever is governed solely by the motion of the counterfaller. As the screw in the quadrant requires to be turned more at the commencement of the formation of the cop bottom than it does as the cop bottom increases, it is found advantageous, at intervals, as the formation of the cop bottom proceeds, to take up a portion of the chain, so as to keep the lever longer out of action. To accomplish this, several modes have been devised, one of such being the use of a ratchet wheel, with a spiral or boss attached to it, to which one end of the chain is fastened; the ratchet wheel, at intervals, being moved by the operative; the chain thereby being wound on the spiral or boss. Another mode is to cause the ratchet wheel, at each stretch, to be moved one or more teeth, until the chain has been sufficiently taken up, when its motion ceases, by means of a stop. Both of these modes are objectionable: the objection to the first being that it requires the ope-

rative to move it, and the objection to the latter being that it is moved each stretch while it is being acted upon; whereas it is not always required, and, being so moved, is disadvantageous. Now, the object of this improvement is to remedy both these defects, which is accomplished by mounting the ratchet wheel and spiral, or boss, on a lever or finger, which is attached to, or actuated by, the counterfaller, in such a manner that the ratchet wheel, when the chain requires to be taken up, will, as the carriage goes in, be in such a position that one of its teeth will come in contact with a catch, which will, as the carriage proceeds in, move it more or less, as is required; and when the chain does not require taking up, the ratchet wheel will be in such a position that, as the carriage goes in, none of its teeth will come in contact with the catch; by which means the ratchet wheel is moved at intervals, when and to the extent required, which is most at the commencement of forming the cop bottom, and which, as the cop bottom proceeds, requires to be diminished.

The figure in Plate IV. is a sectional elevation of part of a self-acting mule, to which the improvement is applied. The winding-on motion, to which the improvement is applied, is constructed after the manner of Lakin and Wain's patent. Motion is imparted to the screw, in the radial arm, to slide the nut on it towards the circumference of the quadrant, by means of the catch *k*, on the lever *j*, which catch acts, when desired, on one of the threads of the spiral drum *g*. The improvement may, however, be applied to mules generally, in which the winding-on is governed by a weighted lever acting on a strap or band, as in the mules known as Roberts's self-actors, as also to various others. *a, a*, are the drawing rollers of the mule; *b*, the roller beam; *c*, the carriage square; *d*, the carriage end; *e*, the faller shaft; *f*, the counter-faller shaft; and *p*, is the lever, called the depressing lever, and employed to depress the counterfaller, with which it is connected by the link *u*, when the carriage arrives at the roller beam: all these parts are common to mules of the ordinary construction. The chain or cord *m*, is, at one end, attached to the finger *y*, fixed to the faller shaft *e*; it passes under the bowl *l*, at one end of the lever *j*, which it thereby supports; and the other end is attached to the spiral or boss of the ratchet wheel *o*. If a chain is employed, it must be made small at the end which is attached to the boss, which is of small diameter, to enable it to wind on easily; or a cord may be attached to the spiral, as shown, and then joined to the chain. The boss may either be made plain, or it may have a spiral cut in it, to guide the chain or cord as it is wound on. The axle of the ratchet wheel *o*, is supported by the lever *p*, to which is also fixed a stud for the retaining catch *q*, taking into the teeth of the ratchet wheel *o*. To the roller beam *b*, is fixed the bracket *r*, in which is a slot for the bolt of the adjustable bracket *s*: to a stud, projecting from this bracket, is jointed the pendent catch *t*, which is held in position, when down, by a stop fixed to the bracket *s*.

The mode of operation is as follows:—The various parts being shown in the positions they occupy when the carriage is going in, at which time the position of the counterfaller is, as is well known, governed by the tension of the yarns as they are wound on, the counterfaller being depressed, if the winding-on is too tight, and elevated, if it is too slack; and the lever *p*, being connected with the counterfaller by means of the

link *u*, and finger *n*, it is also raised or lowered to a corresponding extent. Now, supposing the winding-on is being performed at a rate producing the proper tension on the yarns, the pendent catch *t*, must be so set that the teeth of the ratchet wheel *o*, will, as the carriage goes in to the roller beam, pass under the catch *t*, so as to receive no motion; and the lever *j*, will also remain in such a position that it will not act on the apparatus employed to turn the screw. If the winding-on is too tight, the teeth of the ratchet wheel *o*, also pass under the pendent catch *t*, and receive no motion, as the lever *p*, is at such time further depressed by the action of the winding-on; such depression, however, allows the lever *j*, to act on the apparatus employed to turn the screw. But when the winding-on is too slack, the counterfaller, as before stated, is elevated, and with it the lever *p*, and ratchet wheel *o*, one of the teeth of which, if sufficiently elevated, will, as the carriage goes in, come in contact with the catch *t*, and will be moved by it; the extent of which movement, depends on the height to which the wheel is raised: the higher it is raised, the longer the catch will remain in contact, and the greater the motion it will receive; and the cord or chain *m*, will, at such time, be wound on the spiral or boss of the ratchet wheel *o*. This winding of the cord or chain *m*, on to the spiral or boss, elevates the end of the lever *j*, to which the bowl *l*, is attached, and keeps the lever longer out of action. By means of this improved combination of machinery, the ratchet wheel *o*, is moved, at intervals, when and to the extent required. The chain *m*, which is wound on the boss or spiral of the ratchet wheel *o*, during the formation of one set of cops, must be let off or unwound previous to commencing another set, by turning the ratchet wheel back.

The patentee claims, "The combination of mechanism described, for winding on the chain or cord *m*, according to the tension of the yarn."

To GEORGE DAVIES, *of Serle-street, Lincoln's-inn, for improvements in inhaling apparatus,—being a communication.*—[Dated 22nd April, 1864.]

THIS invention relates to apparatus for reducing liquids to the state of spray for the purposes of inhalation. Hitherto such apparatus has been made to act by means of compressed air or liquid, and a pair of bellows or a force pump was necessary to compress the same to the required degree, before the apparatus would act.

By this invention heated vapours are employed, instead of compressed air, which are better vehicles for conveying the liquid to be inhaled, and the apparatus is also (so to speak) automatic.

The figure in Plate IV. is a vertical section of the apparatus. It consists of a metal case *a*, closed by a cover a^1, which carries at one side the projection *k*. In the case is placed a spirit lamp *b*, furnished with a screw b^1, for regulating the intensity of the flame. Above the lamp is a vessel *c*, containing the water intended to be converted into steam, and is closed hermetically by a stopper c^1. A curved tube *d*, passes through the stopper, and its lower extremity is open to admit

the steam which passes out by the other end, which is brought to a point, having a very small opening. To this tube a second or suction tube *h*, is connected by the elbow pipe *i*: the upper extremity of the tube *h*, also terminates in a point having a small opening, whilst the other end is plunged into the liquid to be vaporised, which is contained in a second vessel *g*. The apparatus being put in action, the steam disengaged in the vessel *c*, escapes by the tube *d*, and blows over the orifice of the tube *h*, carrying with it the liquid from the vessel *g*, in the form of an impalpable powder.

In the vessel containing the steam, a thermometer *e*, is plunged, in which, when the apparatus is working properly, the surface of the column of mercury oscillates between the points 1 and 2; but when this height is exceeded, the temperature must be lowered immediately, by diminishing the intensity of the flame of the lamp. The small spirit lamp *l*, is used to heat the liquid to be vaporised, when necessary.

The patentee claims, "the general construction and arrangement of the inhaling apparatus, as above described."

To JOSEPH SMITH, *of Coventry, for improvements in apparatus for weaving ornamental fabrics.*—[Dated 4th June, 1864.]

THE object of this invention is to effect double or treble figuring on fabrics of broad width—that is, producing detached patterns without a counterpart at the back, with two or more colors, without displacing the shuttles from the batten. To this end, for double figuring, two sets of shuttles are used, that run in the same race, but are driven by independent mechanism, which may operate the two sets of shuttles alternately, or cause either set to throw a succession of shoots, according to work in hand. The batten, with its ornamenting shuttles, is raised the from the work, to allow of the ground being woven, which weaving is effected by the use of the ordinary fly shuttle. The batten is capable of being shifted endwise, so as to distribute the repeats over the ground, instead of their being woven in line with the patterns of the last finished row.

The figures in Plate III. show a double batten, constructed to produce ornamental weaving with three colors. Fig. 1 is a transverse vertical section of the batten; fig. 2 is a partial longitudinal view of the ornamenting batten or battens, carrying the ornamenting shuttles, and the apparatus for operating the same, detached from the batten, and looking towards the inner face thereof; and fig. 3 is a plan view of the under side of the same. *a*, *a*, and *b*, *b*, are the two sets of shuttles which run in the same race in the batten A, and are supplied with silk of different colors. This batten is attached to the ground batten B, by metal straps C, secured to the ends of the ornamenting batten, which straps embrace metal guides D, affixed to the batten B. This mode of attachment allows of the ornamenting batten being lifted out of the shed, to allow the ordinary fly shuttle to act, and form the base of the fabric to be ornamented. When the ornament is required to be woven, the batten A, is dropped, to allow the shuttles to enter the shed. These vertical movements of the batten A, are effected by means of ordinary rocking apparatus, operated by tappets, as will be

well understood by weavers. a^1, b^1, are fixed guide rods, carried by brackets, at the ends of the batten A; upon these rods are mounted, loosely, the driving hooks a^2, b^2, a pair of each of which is required for every shuttle. The ends of these drivers a^2, b^2, enter slots in a horizontal plate c, which slots are arranged as shown in fig. 4. The slots are curved at their ends, as shown, in order to give the driving hooks a swinging motion, and thus to engage them with, and disengage them from, the shuttles, as required. The line of slots a^3, act upon hooks, which drive the shuttles a; and the line of slots b^3, act upon the hooks which drive the shuttles b. For giving the traverse motion to the hooks or drivers a^2, and b^2, the notched bars a^4, b^4, are employed. These bars are supported by fixed guides d, d, and to each of the bars a pair of cords a^5, b^5, is respectively attached, and led through slots cut in the plate c, and over guide pulleys fitted in the batten. These cords are led up to suspended hooks, which are worked by levers and tappets, controlled by the action of the Jacquard apparatus. As, therefore, the draught is put upon one or other of these cords, one or other of the notched bars will be caused to move endwise. The notches are made in the bars, as shown by figs. 5 and 6 (which show the bar detached), for the purpose of receiving alternately one of the pairs of hooks and propelling the same forward. If now, for example, the upper end of a hook or driver a^2, projects into the long slot 1, of the plate c, and is caught in the notch of the bar a^4, as shown, a movement of that bar in the direction of the arrow, fig. 5, for the length of the slot 1, will cause the hook a^2, to carry its shuttle forward in the race a corresponding distance, or close up to the adjacent "space" in the shuttle race. As, however, the driver a^2, reaches the termination of the slot 1, it will enter the curve, which will cause it to rock on its guide rod, and disengage itself from the shuttle which it has propelled thus far. It will also, at the same time, leave the notch of the bar a^4, which now continues its forward course to complete the throw of the shuttle. It now becomes the duty of the other driver of the pair to take hold of the shuttle, which driver is at this time in the curved portion of the slot 2, of the plate c. As the sliding bar a^4, continues its course, a projection 3, upon it strikes against the driver in the slot 2, and causes it to rock on its guide rod, and engage with the shuttle, which is now lying over the "space" in the race. The further forward movement of the sliding bar will cause the driver to carry the shuttle to the end of its course. The bar b^4, will now come into action, and by means of the drivers b^2, the shuttles b, will be acted upon in a precisely similar manner to that described. Thus, supposing the shuttles a, to carry red silk, and the shuttles b, the blue, a blue and red shoot will be alternately laid in the fabric, to produce the double figuring required.

It will be obvious from the above explanation, that a succession of shoots may be thrown by either set of shuttles, to suit the requirements of the pattern in hand; the jacquard controlling which of the pairs of cords shall be operated upon after every completed shoot.

The patentee claims,—"placing two or more sets of ornamenting shuttles in one and the same race, and actuating them in the manner and for the purpose above described."

To JOHN BASSETT ELWELL, *of Priestfield, near Bilston, Staffordshire, for improvements in the construction of ships' masts and spars.*—[Dated 6th January, 1864.]

THIS invention consists in constructing ships' masts and spars of tubes composed of sheets or plates of metal connected together in such manner, that the joints uniting the side edges of the plates shall run spirally from end to end of the mast or spar, the plates being for this purpose bent to the requisite spiral form; by which means the masts or spars will be of much greater strength than when the joints of the plates run parallel with, and also at right angles to, the length of the mast or spar. The joints that run spirally from end to end of the mast or spar are formed by making the edges of the plates overlap each other, and connecting together the overlapping edges by rivets; and where two plates come together end to end, they are connected together by butt joints, the neighbouring ends of two plates being each rivetted to a short plate that overlaps both of them,—this short plate being interior of the mast or spar. The sheets of metal employed are made of such a width that it will require two, three, or more plates, bent to the requisite curve and connected together side by side, to form the circumference of the mast. The spiral to which the plates are bent should be such that the spiral lines formed by the joints, by which the side edges of the plates are connected together, shall pass entirely around the mast in a length equal to about nine or twelve times its diameter, but this may be greatly varied. Where the mast is required to be tapered, the plates are cut to the requisite taper form, and are bent to the requisite curve by means of rollers; and strengthening ribs of T or angle iron may, if desired, be employed interior of the mast.

The figure in Plate IV., shows a side view of a portion of a mast constructed in the manner above described, and other spars are constructed in a similar manner. The cheeks and other fittings of the mast may be formed and applied in the manner usual in constructing metal masts.

To WILLIAM COLBORNE CAMBRIDGE, *of Bristol, for improvements in the manufacture of iron.*—[Dated 29th April, 1864.]

THE object of this invention is to expedite the fusion of the metal (whereby a great economy of fuel is effected), and also to improve the quality of the iron produced. In carrying out this invention, the patentee takes a mixture of crushed ore, in pieces of about half an inch in diameter, in the proportion of one-third part of calcined black and clay-band ores, one-third part of brown hematite, and one-third part of red hematite ore; and to each ton of such crushed ore he adds about a bushel, or a bushel and a-half, of slacked lime, or any other suitable flux, and also wrought and cast-iron filings, borings, shavings, or other small pieces of iron. The crushed ore and flux, and the iron turnings or borings, he mixes intimately together, with the addition of a sufficient quantity of water to bring the materials into a thick pasty state. As the ingredients are thus brought into direct contact with each other,

the fusion of the ore in the furnace will be materially assisted and a great economy of fuel will be effected.

The quality of the iron will be improved by the addition of the iron filings or turnings, and its special characteristics may be regulated by mixing these substances with the ores and flux, in such proportions as the quality of iron required shall dictate. In practice, it is found that from seven per cent. upwards (according as hardness or strength, or both, may be wanted) of these cast-iron borings or filings, and wrought-iron turnings or small pieces of either cast or wrought-iron, may be advantageously added to the other materials. This admixture of materials, when reduced to a thick paste, is formed into lumps or bricks, and then dried, preparatory to being submitted to the action of the furnace. When bricks or lumps made in this manner are to be used in the furnace, in combination with broken ore, the proportions of the iron filings are varied; for instance, the fine waste screenings of brown or red hematite ores, or both, are mixed with slacked lime, in the proportion of about one and a-half bushel of lime to the ton of pulverized ore, and ten cwts. of cast-iron turnings, borings, or filings, and about the same quantity of wrought-iron scrap, or turnings or borings, are added thereto.

The patentee claims, "mixing broken or pulverized iron ore with a suitable flux and water, so that the ingredients may be brought into a pasty state, and formed into bricks or blocks, with the addition of cast or wrought-iron turnings, filings, borings, or other small pieces of iron, as herein set forth."

To D'HERMAN LOMER, *of Brussels, for obtaining coloring matter as a substitute for aniline colors.*—[Dated 21st April, 1864.]

THIS invention consists in an improved method of obtaining coloring matters from aloes and bitumen of India. This coloring matter has a very striking resemblance to, and with suitable mordants is quite equal to, colors derived from aniline, in brilliancy and variety of shade.

The following is the process:—Take thirty-five ounces of aloes rocotrina and thirty-five ounces of bitumen of India, and grind them to fine powder; then treat the fine powder in an earthenware vessel with ten times its weight of nitric acid, of the specific gravity of 1·230, adding the acid in small portions at a time till the whole quantity has been introduced, and evaporate the resulting product to dryness. This dry resinous mass must now be pulverised, and introduced into a suitable metallic boiler, capable of sustaining an internal pressure of at least twelve atmospheres; at the same time, sulphuret of carbon amounting to ten times the weight of the powder is put into the boiler, and the lid of the boiler is firmly screwed on, and a gentle heat applied. After twelve hours' application of heat, remove a portion of the contents of the boiler for examination, and repeat the operation until, on examination, the required shade of color is obtained.

The patentee claims, "an improved method of obtaining coloring matter from aloes and bitumen of India, as substitute for aniline colors.

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

December 13th, 1864.

CHARLES HUTTON GREGORY Esq., Vice-President, in the Chair.

The discussion upon Mr. Joseph Taylor's paper, on "*The River Tees, and the works upon it connected with the navigation*," occupied the whole evening; and not having been concluded, the publication of the abstract was deferred.

After the meeting, Mr. F. B. Doering exhibited and explained a level, which, for readier adjustment, was supported upon a gimbal joint, instead of on parallel plates; and he stated that the plan was applicable to other surveying instruments. The method was similar to that adopted for a ship's compass, with the addition of vertical arcs, at right angles to each respective axis, which were clamped to each other and to the frame that was screwed on to the ordinary tripod stand. In the field, when using this instrument, however uneven the ground might be, the legs were put down in the most convenient manner, irrespective of level. The clamps, holding the telescope rigid with the stand were then slackened, and the telescope set approximately level by hand. The clamping screws were then tightened, and the final adjustment effected by two tangent screws at right angles to one another, and connected respectively with each arc at the clamps. On moderately level and firm ground, it was not necessary to unclamp the joint of the instrument, as it might be set up approximately level in the ordinary way by the legs, and be brought to a perfect adjustment at once by the tangent screws. By dividing one of the arcs into degrees, the instrument could be used for measuring vertical angles, and thus the height of any point at a distance, required for checking, might be obtained. It was believed that, by this method, a level could be set up on sidelong, soft, or broken ground, with as much ease as on firm, level ground; and that, as none of the moveable parts were liable to become jammed, as in the parallel plate system, a more perfect adjustment was practicable. A level constructed in this manner had been tried in wet weather and in high winds, and proved to be as steady as any instrument hitherto made.

December 20th, 1864.

JOHN FOWLER, Esq., Vice-President, in the Chair.

ANNUAL GENERAL MEETING.

In presenting an account of the proceedings during the past twelve months, the Council reported that the characteristic feature of steady,

progressive development was never more fully exemplified, in any similar period, since the first establishment of the Institution. The meetings had proved very attractive, the discussions had been well sustained, the library was fast becoming rich in all professional and scientific works of this and other countries, the number of Members and Associates had greatly increased, and the financial condition was very satisfactory. The importance to engineers of being connected with the Institution was felt more and more every day; and although the time had not yet arrived when it was considered imperative for every one practising the profession to have received the diploma of the Institution, yet in general opinion it might fairly be said that that position had been attained. On these grounds, therefore, it was more than ever essential that the qualifications of all candidates for admission should be most scrupulously examined, and that the Members should satisfy themselves, before signing any proposition paper, that the person so recommended possessed such character, practice, and experience, as to entitle him to the distinction he sought.

There had been twenty-three Ordinary General Meetings during the session, when eleven Papers had been read, many of the evenings having been entirely occupied by discussions. The communications related to the details of erection of three lighthouses for facilitating the navigation of the northern portion of the Red Sea; to the causes of the decline in the duty of Cornish pumping engines; to the circumstances which determined the velocities of influx and reflux, and consequent scour, attendant on the final closing of embankments for reclaiming land from the sea, or from a tideway; to a description of the features of, and changes in, that portion of the East Coast of England between the Thames and the Wash Estuaries; to the actual state of the works in the Mount Cenis Tunnel, perhaps the most important and interesting work of civil engineering in the present day; to an inquiry into the resistances to bodies passing through water; to the Santiago and Valparaiso Railway; to the structure of locomotive engines for ascending steep gradients, when in combination with sharp curves, and to the impedimental friction between wheel tyres and rails; to the distillation of coal and the manufacture of coke; and to the machinery employed in sinking artesian wells on the Continent.

With regard to the publication of the Minutes of Proceedings, it was stated that Volumes XXI. and XXII. would shortly be issued, and that the General Index to the series of volumes from I. to XX. inclusive—in itself a volume of about four hundred pages—was also nearly ready.

A new edition of the Catalogue of the Library was in preparation, in continuation of that issued in 1851, now out of print. At that date the library contained upwards of three thousand volumes and fifteen hundred tracts; now the collection amounted to about five thousand five hundred volumes and three thousand tracts.

The tabular statement of the transfers, elections, deceases, and resignations, showed that the number of elections had been 93, of deceases 25, of resignations 6, and of erasures 7,—leaving an effective increase of 55, and making the total number of Members of all classes on the books on the 30th of November last, 1095. This was an increase of nearly 5·3 per cent. in the past twelve months.

The deceases announced during the year included the names of many very old Members, several of whom had been engaged under the first President, Telford, as well as one of the six founders of the Institution —Mr. James Jones—who, in its early days, acted as Secretary, and whose death, at an advanced age, was the result of a lamentable accident.

The abstract of the receipts and expenditure for the year ending the 30th of November last, as prepared by the auditors, showed that the payments during the twelve months had amounted to £2955, against receipts from all sources of £4414; and that the amount obtained from subscriptions and fees alone, without including the dividends upon investments, and the sums derived from other sources, had exceeded the disbursements by about £450. The Council had, therefore, been again enabled to add to the Institution Fund, by the purchase of £1000 Four per Cent. Debenture Stock, of the London, Brighton, and South Coast Railway Company. On comparing this statement of accounts with the average of the previous ten years, it appeared that the total income now exceeded that average by nearly 40 per cent., while the increase in the disbursements during the same period had been less than 20 per cent. The realised property of the Institution now comprised:—I. General Funds, £10,819. 12*s*. 10*d*.; II. Building Fund, £1751. 0*s*. 1*d*.; and III. Trust Funds, £9970. 12*s*. 7*d*., making a total of £22,541. 5*s*. 6*d*., as against £20,649. 16*s*. 2*d*., at the same period last year.

The propriety of establishing a Benevolent Fund in connection with the profession received the serious consideration of the Council before any steps were taken to ascertain the views of the Members generally. It was well pointed out by Mr. F. J. Bramwell (M. Inst. C.E.), with whom the present proposal originated, that in most, if not in all, other professions and occupations there was a regularly organised system for the aid of decayed members, and of the families of deceased members, when in necessitous circumstances; and that inasmuch as the civil engineers already formed a numerous and increasing body, in some respects more liable to those misfortunes and vicissitudes, which were known by experience to overtake those following other pursuits, it was incumbent on the profession that some business-like action should be taken, in preference to soliciting subscriptions for individual cases, now unfortunately found to be frequently requisite. Private inquiries among a few of the Members of the Institution having shown that such a fund, if properly managed and adequately supported, could not fail to be productive of immense good, it was determined to appeal to the general body, and the result had been such a response as fully to justify the course which had been pursued. Already, from 224 contributors, donations to the amount of £21,884, and annual subscriptions to the extent of £487, had been promised. Of these contributors, 97 were donors only, 14 were both donors and annual subscribers, and 113 were annual subscribers.

At the meeting recently held in the rooms of the Institution, the Fund was formally established, and that portion of the General Committee which it was recommended should be elected by the contributors was appointed. At the same time the Committee was requested to prepare a scheme, with bye-laws and rules, for the administration of

the Fund, and to report the result of their deliberations to a general meeting of the contributors, to be summoned for the 17th of January next. The Council would not venture to anticipate what might be the issue of the considerations of the Committee, but they felt assured that a measure so calculated to enhance the character of the profession would be cordially supported; and on every ground they commended it to the most favorable notice of the Members.

If the object of the profession of a civil engineer be, as described in the Charter of Incorporation of the Institution, "the art of directing the great sources of power in nature for the use and convenience of man," it might fairly be asked—what other profession played so large a part in developing the material resources of the world, and in facilitating that intercourse between nations which tended to promote peace and goodwill? It should then be the constant endeavour to make the Institution the depository of the accumulated knowledge of all the Members; and all should strive so to sustain and consolidate the Institution, that it might continue truly and faithfully to represent the important interests committed to the care of the civil engineer.

After the reading of the Report, a Telford Medal and a Telford Premium of Books were presented to Mr. W. Lloyd; a Telford Medal to M. Pernolet; a Telford Medal and the Manby Premium, in Books, to Mr. G. H. Phipps; Telford Premiums of Books to Messrs. J. B. Redman, W. Parkes, T. Sopwith, junior, J. M. Heppel, and G. R. Burnell; and Watt Medals to Messrs. T. Sopwith, junior, W. Bridges Adams, and J. Cross.

MECHANICAL ENGINEERS' SOCIETY.

5th May, 1864.

JOHN RAMSBOTTOM, Esq., Vice-President, in the Chair.

The first paper read was, "*A description of Harrison's cast-iron steam boiler*," by Mr. Zerah Colburn, of London.

The importance of high-pressure steam as a condition of steam engine economy has long been understood. Trevithick, as early as 1804, worked an engine at what was then regarded as an enormous pressure —50 lbs. per square inch. His American contemporary, Oliver Evans, recommended a still greater pressure—150 lbs. per square inch, cut off at one third of the stroke; and from the records of the department for supplying Philadelphia with water, it appears that Evans actually employed not only this pressure, but still higher pressures, on the large scale of pumping engines. In 1817, one of his engines was started at the Fairmount Waterworks, Philadelphia, and was worked regularly at from 194 to 220 lbs. per square inch; the engine cylinder was 20 inches diameter, and the stroke of the piston 5 feet, the usual working speed being 25 revolutions per minute; steam was supplied from four cylindrical boilers, 30 inches diameter and 24 feet long, fired externally. A Boulton and Watt engine of 44-inch cylinder and 6-feet stroke had

been started two years previously at the same waterworks, having a cast-iron boiler with vertical wrought-iron flues, with a steam pressure of only 2½ to 4 lbs. per square inch. Both these engines pumped through a 16-inch main, 239 feet long, into a reservoir 102 feet above the level of supply. Trials of twenty-four hours duration showed that the low-pressure engine had rather the advantage over the other, in point of economy. The former pumped into the reservoir in twenty-four hours 1,763,104 gallons of water, with a consumption of 896 cubic feet of wood, being 1968 gallons per cubic foot; while the high-pressure engine, in raising 3,124,891 gallons through the same main, consumed 1664 cubic feet of wood, or at the rate of 1878 gallons per cubic foot.

Steam of rather more moderate pressures than Evans employed, or of about 100 lbs. per square inch, continued subsequently to be employed in America, notwithstanding the frequent explosions of high-pressure boilers. In England, the boilers for Trevithick's engines were made of large diameter, and of cast iron; and many of them were made at the Bridgenorth Foundry with an internal diameter of 8 feet, and in 8-feet lengths, which were connected together by flanges and bolts up to any length required. Such boilers were unquestionably dangerous, although many wrought-iron boilers of equal or greater diameter, and probably of less strength, are worked up to the same pressure now. An occasional explosion of a Trevithick boiler, and the influence which the practice of Boulton and Watt then exercised, soon occasioned a general return to low pressures, except in Murray's, Stephenson's, and Hedley's locomotives, which were worked regularly at 50 lbs. per square inch.

Within the last thirty-five years, however, or, in fact, coincident with the progress of improvements in boiler making, there has been a corresponding tendency to return to high pressures. The locomotives on the Liverpool and Manchester Railway worked in 1830 with steam of 50 lbs.; by 1843, pressures of 75 lbs. and 80 lbs. had become common upon railways; 100 lbs. to 110 lbs. was regularly maintained in 1851; and at the present time 120 lbs. is the usual, and 160 lbs. an occasional, pressure in locomotive boilers. The last-named pressure is not very much below that recommended for locomotives by the late Jacob Perkins, nearly thirty years ago, who preferred steam of 200 lbs. cut off at one eighth of the stroke. In marine engines, an ordinary working pressure of 25 lbs. has been reached, while some of the Liverpool and Montreal vessels are worked at 40 lbs., and the Pacific Mail steamers at 50 lbs., per square inch. For ordinary land engines even 100 lbs. pressure has been adopted in many cases; and this and still higher pressures are already employed by some makers of portable and traction engines.

Although the construction of boilers has been much improved, in order that higher and higher pressures might be obtained, it is certain that great room for improvement is yet left. The old boiler fired externally is objectionable, while for internal firing it is necessary either to have a fire-box and tubes, or to have flues large enough to allow the fireplaces to be formed within them. The multitubular boiler, unless supplied with good water, requires much care to prevent choking with scale, and its repairs are in all cases greater than those of the Cornish and Lancashire boilers. The Lancashire or two-flued

boiler is that most used in the manufacturing districts, but its diameter is necessarily so large as to render it imprudent in most cases to load it with steam of much more than 50 lbs. pressure; and this is not the high pressure to which present steam engine practice is tending. A diameter of 7 feet is common for Lancashire boilers; and if made of ½-inch Staffordshire plates, single rivetted, their bursting pressure may be taken as 333 lbs. per square inch. This estimate is made upon Mr. Fairbairn's usual allowance of a loss of 44 per cent. in the strength of the solid plate at single-rivetted seams; and the estimate of course assumes that no flaws are hidden in the iron, and that the workmanship is good, the rivetting being fairly done so that the boiler shall not have been injured by the use of the drifting tool. This, then, is the limit of strength when the boiler is new, and it would be manifestly imprudent to press to more than 50 lbs., or at the utmost 70 lbs., a boiler which was certain to burst at 333 lbs., and to be permanently injured by a much lower pressure. It is shown, moreover, by the reports of the Manchester Boiler Association, that many boilers are subject to weakening from corrosion or furrowing of the plates. A leakage of steam, however slight, from any part of the boiler into the adjacent setting is almost certainly attended with corrosion. Condensed steam, that is distilled water, appears to exercise a strong solvent power upon iron, as is known in the cases of boilers supplied with very soft water or peat water, or more especially those fed with water from surface condensers. As has been shown in the case of several recent boiler explosions, the thickness of boiler plates is often wasted nearly through by unsuspected corrosion. This source of danger to a certain extent neutralises the means occasionally resorted to for securing great strength in boilers, such as the use of steel or homogeneous metal plates, double rivetting, thick-edged plates, welded joints, &c.

Whenever a failure unhappily occurs in the plates or rivetting of a boiler, the destructive effect appears to depend not merely upon the pressure under which the failure takes place, but also, and probably still more, upon the quantity of water contained in the boiler. The effect of the boiling water in an explosion may be considered as analogous to that of gunpowder, and, as in the case of gunpowder, the effect is proportionate to the quantity exploded. It is preferable, therefore, while increasing the strain upon boilers by increasing the pressure of the steam, to diminish at the same time the quantity of water contained in them; doing so, of course, without exposing any part of the boiler to the direct action of the fire on one side of the plates where there is no water present on the other. In a large Lancashire boiler, the object of carrying so much as from 15 to 20 tons of water is mainly to ensure that all the heating surfaces shall be fairly covered, and with this construction of boiler a smaller quantity of water will not answer that purpose. A certain body of water is indeed necessary to prevent sudden fluctuations in the pressure of steam; but in the majority of cases a few hundred gallons at most is quite enough for this purpose; and especially where means are employed for drying or superheating the steam, there will be neither sudden alterations in the pressure nor difficulty in respect of priming, even where only a small body of water is maintained in a boiler, and where the water level or surface from which the steam rises is of but small

area. Moreover, it should not be forgotten that with all steam boilers the whole, or nearly the whole, of the fuel employed in raising steam from cold water at starting is lost when the boiler stops work at the end of the week, especially where the boiler has then to be blown out. To heat 20 tons of water from its ordinary temperature in the open air to 300° Fahr., the temperature corresponding to a steam pressure of 50 lbs. per square inch, will seldom take less than 15 cwts. of coal, in addition to that lost in heating the brickwork setting of the boiler. On this account, therefore, it is desirable to work boilers with as small a quantity of water as will suffice for every necessary purpose.

The cast-iron boiler about to be described has been constructed with reference to the foregoing considerations. It was the object of the inventor, Mr. Joseph Harrison, of Philadelphia, United States, to provide great strength against bursting, and to obtain also a large extent of heating surface, in proportion to the weight and external dimensions of the boiler: it was important, moreover, to obtain perfect circulation for the water. The experience with this boiler, for several years in America, and for upwards of two years in London and Manchester—in one case with a boiler supplying steam to the extent of 200 indicated horse power, has proved that these objects, as well as other important advantages, have been secured.

The several parts of the boiler received different forms in the earlier experiments several years ago, but these led to the adoption of hollow cast-iron spheres, connected by hollow necks, the several castings composing the water space being secured together by bolts. The spheres are each 8 inches external diameter, ⅜ inch thick, and connected by necks of 3½ inches opening. Each of these castings is called a "unit." Each unit of four spheres has eight openings, 3½ inches internal diameter, the edges of which are faced up to a true surface, so as to bear fairly upon the corresponding faced surfaces of the adjoining units. Each joint has a shoulder and socket, so as to steady the units in their place. Steam-tight caps are provided to cover the external openings; and the whole series of units, forming a vertical slab of rectangular or other shape, are held together by bolts of 1¼ inch diameter, passing inside the spheres and through the water or steam which they contain.

Each slab, whatever number of units it may be composed of, may be regarded as a separate vessel, throughout which the water or steam can circulate freely, both vertically and longitudinally. Any number of slabs may be placed side by side in the same fireplace; in the boiler described, there are eight: they are connected together by a feed-water pipe at the bottom, and by a steam pipe at the top. The water level is usually maintained, so that about two-thirds of the whole number of spheres will be constantly filled with water, the remaining spheres forming a steam space. The full heat of the fire is prevented from coming upon the upper spheres, which contain only steam, by small firebrick screens or cast-iron plates, which are placed loosely between the slabs, a little below the water level, so as to confine the direct action of the heat chiefly to the spheres filled with water. The upper spheres are at the same time enveloped in an atmosphere so hot as to ensure the steam being completely dried. The slabs are fixed with an inclination in the direction of their length, sufficient to ensure the complete drainage of all the spheres when the boiler is blown out. This inclina-

tion serves at the same time to bring the largest body of water to where the action of the heat is most direct, and to provide the largest steam space over that part of the boiler where ebullition is probably the least active. The earlier experiments showed that, although the units might be bolted together into slabs of a total length of even 20 feet, a length of 9 feet was preferable, since the strain upon the bolts, in screwing up, was correspondingly less: and as, in the latter case, there was no observable tendency to sag in the centre, the complete tightness of the joints was thereby secured.

The spheres weigh each about 22½ lbs., a unit of four spheres weighing rather more than ¾ cwt. Hence there are very nearly one hundred spheres to the ton; and it has been the habit, thus far, to rate these boilers by their weight—as a 4-ton boiler, an 18-ton boiler, &c. The nominal horse power of the boiler may be generally taken as three times its weight in tons. Thus, a 10-ton boiler may be rated as of 30 nominal horse-power; and, from experiments, it appears that a boiler of this weight may be counted upon to evaporate 40 cubic feet of water per hour, corresponding to about 80 indicated horse-power. Each sphere contains seven pints of water, a unit of four spheres containing 3½ gallons. The external surface of each sphere is rather more than 1¼ square feet, and the internal surface a little more than 1⅛ square feet. In round numbers, it may therefore be said that each sphere presents a square foot of heating surface and contains a gallon of water; while a ton of 100 spheres represents three nominal horse-power, the proportion of weight to power being thus about the same as in Lancashire boilers of the ordinary type.

Although it cannot be said that cast iron is, in itself, a strong material for boilers, yet it will be seen that, in the form now described, it affords greater absolute strength against bursting than is possessed by any form of plate-iron boiler at present in use. The units are cast upon green sand cores, so placed that they cannot alter their position in the flask by any force short of what would be sufficient to crush them to pieces. The thickness of metal in the spheres is, therefore, uniform throughout, as has been proved by breaking great numbers of units taken at random. In a unit of four spheres, each sphere having an internal diameter of 7¼ inches, the whole area of the plane in which a bursting pressure would act, taken through the eight openings of the four spheres, is 220 square inches; while the least section of iron resisting this pressure, in the same plane, is 27½ square inches. The iron employed is an equal mixture of Glengarnock, Carnbroe, and scrap—a mixture selected for its free running quality, and much used for small machinery castings. Its tensile strength may be safely taken as 5½ tons per square inch. At this rate, the bursting strength of the units would be 1540 lbs., or nearly three-quarters of a ton per square inch internal pressure. The first experiments actually made to test the bursting strength of the units, were made more than two years ago in Brussels, for the Belgian Minister of Public Works. In this case, a pressure of 98 atmospheres, or 1440 lbs. per square inch, was applied. This was as high as the force pump employed could go, but the spheres were not burst.

A further series of experiments, for the purpose of testing the bursting strength of the cast-iron spheres, have recently been made at the

Gorton Foundry, Manchester. A high-pressure Schaeffer's gauge, graduated to 1000 lbs. per inch, was attached to one of the units or castings of four spheres, to which the caps had been accurately ground, and water pressure was then applied, by means of a force-pump. The pointer of the gauge passed the 1000 lbs. mark to an extent indicating from 1150 lbs. to 1200 lbs., but the spheres did not burst. The pressure gauge was then checked, by comparison with a Bourdon gauge, up to 500 lbs. per square inch, and found to agree within 10 lbs. By calculation, from the weight applied to the force-pump lever, and the dimensions of the pump, it was estimated that the total force applied, including the friction of the pump, was about 1470 lbs. per square inch. Another similar casting was afterwards tested in the same way, with a similar result. The castings were subsequently broken with a sledge-hammer, and showed a uniform thickness at all parts, and a good quality of iron. A safety-valve was then arranged, for the purpose of ascertaining the bursting strength of the spheres; the seat of the valve was ¼th square inch area, and the head of the valve 1¼ inch diameter, the valve being ground carefully to its seat. The spheres were burst at a pressure calculated at 1850 lbs. per square inch; but on comparing the safety-valve with a pressure-gauge, it appeared that water must have worked its way over the ground seating of the valve, allowing the pressure to act upon a greater area than ¼th square inch, and that the true pressure could hardly have been so much. The head of the valve was then reduced to a diameter of ⅞ inch, and the spheres were burst at a calculated pressure of 1650 lbs. per square inch; but it was still found that some water must have worked over the valve seating, and the experiments with the safety-valve were not, therefore, altogether satisfactory, but there appeared no reason to doubt that the bursting pressure was not far short of 1500 lbs. per square inch. All these experiments were made upon castings having their covering caps ground carefully to them, and the bolts were only about 9 inches long between the caps covering the opposite openings of the units. When, however, a slab of, say, 100 spheres, is bolted together, the bolts, being upwards of 9 feet in length, become so far stretched by a strain considerably below the bursting pressure, as to cause the joints to open everywhere and relieve the pressure. In this way, every joint becomes a safety-valve. This never occurs with any practicable steam pressure, but it did take place in many of the earlier experiments made to burst the spheres, although leakage seldom commenced until a strain of nearly or quite half a ton per square inch had been applied.

The above experiments were all made with new castings, and at the time they were made no other spheres could be had which had been more than twelve months in use; and the condition of these was clearly the same as when new. It would appear, therefore, that the boiler now described possesses the same degree of safety under a pressure of 230 lbs. per square inch, as a 7-feet Lancashire boiler under a pressure of 50 lbs. If, however, one of the units of the cast-iron boiler should burst, it could not do more than empty itself, and open one or more 3½-inch apertures into the units adjacent to it. Whereas, if an ordinary boiler, containing, say, 20 tons of highly-heated water in one compartment should burst, the consequences would be

most disastrous. In some of the earlier boilers of the kind now described, the setting was such that an excessive strain was brought upon one or more joints; and here, in order to prevent leakage, the bolts had to be tightened with great force, and in two or three cases, castings, forming a part of the boiler, were thus cracked from one joint to another. The consequence was an escape of steam or water, but no further damage ensued. In one of these instances, a unit thus cracked was worked continuously for three days, and it might, perhaps, have been worked for a still longer time; but it was thought prudent to replace it by a sound casting. No instance of a fracture has occurred in the cast-iron boilers with the present mode of setting, and all the boilers of this kind yet erected are quite free from leaks at the joints.

The bolts securing the castings together have a strength much beyond even that at which the spheres would burst. They are under a certain initial strain before any pressure is raised in the spheres; but the amount of this initial strain is known and under control, for in screwing up the slabs a 27-inch wrench is employed, and the strength of but one man is applied to it. If, however, a great strain be put upon the bolts, the crushing strength of the castings is found to be greater than the tensile strength of the bolt. In a series of experiments made at the manufactory of these boilers by Mr. Luders, a slab of units bolted together to a length of 9 feet was screwed up with great force: a wrench 10 feet long was employed—the force of three men applied. In every case the castings were compressed to the extent of $\frac{1}{8}$ inch in a length of 9 feet, when the bolt commenced to stretch, and, after elongating $1\frac{1}{4}$ inch, it broke. This experiment was repeated twelve times with the same result; the castings remaining uninjured.

It might have been apprehended that the expansion of the castings, when in service in a boiler, would be such as to cause unequal strain upon the joints. No leakage, however, can be detected at any of the joints of a single slab of castings; and as each slab is supported chiefly at its lower corner, and all the slabs of a boiler are separate from one another, except at a single point at top and bottom, where the steam and water connections are respectively made, it is found that the slabs are under no injurious strain. Moreover, all the spheres have a considerable amount of elasticity under strain, which would assist in compensating for unequal expansion, did this exist. These conclusions as to the effect of expansion are derived from an experience of $2\frac{1}{2}$ years with one of these boilers, of 12-horse power, at the chemical works of Messrs. Denton, at Bow-common, London; two boilers, one of 50-horse power and the other of 12-horse power, at the engineering works of Messrs. Hetherington, Manchester; and a 12-horse power boiler at the manufactury of these boilers, Openshaw, Manchester. The two boilers at Messrs. Hetherington's are often worked, collectively, up to 200 indicated horse power: the first was erected at their works about eighteen months ago. The boilers of this construction were originally bolted up in slabs 25 feet long, where considerable power was required; but in such cases it is now preferred to employ two or three slabs—one behind the other—each slab being eight or nine feet long. When this arrangement was first employed, the steam space of the back slab was connected by a pipe with that of the front slab, the steam being taken off to the engine from the front slab alone; and the steam pipes con-

necting the front and back slabs being made of cast iron, and of a form which did not allow of the unrestricted expansion of the slabs, some of the pipes consequently cracked; but they are now made of wrought iron and of a curved form, so as to yield readily to a moderate strain.

The inventor of this boiler, Mr. Harrison, had, from the first, expected an entire freedom from corrosion of the spheres; and the experience, thus far, has borne out this anticipation. Cast iron is well known to endure much better than wrought iron under the action of flame, water, and other corrosive influences. In the case of gas retorts, for instance, plate iron would be immediately burnt through; whereas, previous to the introduction of clay retorts, cast iron answered very well. The pipes for heating the blast of blast furnaces were originally made by Mr. Neilson of plate iron; but, although the blast was then heated to only 350°, it immediately became necessary to resort to cast-iron heating pipes. The superior durability of cast-iron forge tuyeres, especially when made hollow and lined with water, is also well known. In the case of the present boiler, many castings have been purposely removed and examined after being at work; but their weight has been found the same as when they went in, and the joints showed no degradation of their original surface.

The question which caused most apprehension in the first instance, in connection with this boiler, was the possibility of maintaining a clean surface within the spheres. The cast-iron boiler may be said to belong to the class of water-tube boilers, or those having small water cells. This class of boiler is about sixty years old, for one was fitted in Meux's brewery in London by Arthur Woolf in 1804; and in the same year a small screw steamboat was worked on the river Hudson by John C. Stevens, of New York, the engine of which was made by Boulton and Watt, while the boiler had 81 water tubes, 1 inch diameter and 2 feet long. From the first, however, such boilers have generally failed, on account of defective circulation and the difficulty of keeping the tubes free from internal deposit. Many attempts have been made to remove this difficulty. Circulating pumps have been employed, in addition to the ordinary feed pump, to maintain a constant circulation of water through the tubes. The boilers of the first American steam fire-engines were thus constructed. Other forms of water-tube boilers have been made, with different means for promoting a circulation of the water; but in all cases the whole of the inorganic matter contained in the feed water must remain in the boiler, unless it be blown out while working; and in the case of some salts held in solution by ordinary boiling water, these are inevitably, and almost irremovably, deposited upon some part of the internal surfaces. The boiler now described forms no exception to the general experience in this respect. The water with which Messrs. Hetherington's boilers, and indeed most of those in Manchester, are fed is such as to deposit a hard scale, ⅛ inch thick, after a few weeks' working. A tool had been contrived, with steel scrapers, so hinged that it might be entered through any of the openings in the spheres of the cast-iron boiler, and be then expanded out to the internal circumference of the spheres: by then working this tool within the sphere, the scale would be removed, so that it could afterwards be blown out.

It has unexpectedly turned out, however, that no occasion has arisen

for the use of this scraping tool. The boiler was blown out regularly at the end of every week, and it was found that the supply of steam continued good without any use of this tool, and that none of the spheres became overheated or leaking. After ten months' work of the 50 horse-power cast-iron boiler at Messrs. Hetherington's, it was desired to increase the boiler power at their works, and as the boiler then in use there was formed of units, having only two spheres each, it was replaced with a new boiler having four spheres in each unit, excepting the units employed for breaking joint, which had two spheres as before. On taking down the old boiler, little or no scale was found in any of the spheres; two of which, in the same condition as when taken down, were exhibited to the meeting. It is probable that, as the spheres expand at all parts, and, in cooling, contract equally at the same parts, the scale is detached and crushed in this process of contraction. If this conjecture be correct, the unexpected separation of the scale may be attributed to the form and dimensions of the spheres themselves.

The evaporative efficiency of the cast-iron boiler depends, as in the case of all other boilers, upon the amount of heating surface exposed in proportion to the consumption of a given weight of fuel in a given time. The boiler, by which Messrs. Hetherington's works are now driven, supplies an amount of steam which a single Lancashire boiler, 7 feet diameter, 30 feet long, and weighing 14 tons, was found inadequate to produce. Both the original and the present boiler are in connection with a chimney 165 feet high, which affords an excellent draught. The original boiler had two flues, each 2½ feet diameter, and enlarged at the fire-place to 3 feet. The area of the fire-bars was 36 square feet, and the total "run" of the heat was 90 feet in length before quitting the boiler. The cast-iron boiler now in use has about 1800 spheres, weighing 18 tons, and presenting about 1600 square feet of surface in the water spheres, and about 700 square feet in the steam spheres: the area of fire-grate is 33 square feet. The usual quantity of water carried is 147 cubic feet, or rather more than four tons; the quantity usually carried in the original Lancashire boiler being nearly 20 tons. The external dimensions of the present boiler are considerably less than those of the Lancashire boiler. Rather more than 3 cwts. of coal are required in the cast-iron boiler for raising 50 lbs. steam from cold water, and the time occupied is about half an hour. In order to ascertain the exact evaporative efficiency of the boiler, it would be necessary to begin the observations when it was in full work, and to continue them, uninterruptedly, for a considerable time. As the boiler is now worked, the fires are lighted on Monday morning and let down on Saturday afternoon; but they are banked every day at breakfast time, at noon, and at night. The mass of brickwork, which is thus alternately heated and cooled with the boiler, is very great; and the quantity of heat that enters it—which is, for the most part, wasted on stopping—is correspondingly large. Except at the beginning of the week, the temperature of the water in the boiler, on starting in the morning, is at least 212°, while the feed water from the hot well is usually between 90° and 100°.

In February last the writer made a series of careful observations upon the working of this boiler, more especially to ascertain its evaporative

efficiency. The coal was of good quality, from the Oldham Pits, and was carefully weighed; and the feed water was made to pass through one of Worthington's water meters on its way to the boiler.

In a whole week of 57½ hours, an average of 77 cubic feet was evaporated per hour, the maximum evaporation being about 82 cubic feet per hour; and the average consumption of coal was 6·25 cwts. per hour. This corresponds to 6·85 lbs. of water per lb. of coal; but, allowing for the sources of loss already pointed out, nearly 8 lbs. may be taken as the effective rate of evaporation. The temperature of the escaping gases, as indicated by Gauntlett's pyrometer, was about 600° on the average; the steam of 50 lbs. pressure showing the normal temperature of about 300°, by a thermometer inserted for the purpose. The average rate of combustion was 21 lbs. of coal per square foot of fire-grate per hour. When the fires were not driven so hard, the rate of evaporation per lb. of coal was increased, and the temperature of the escaping gases fell to 525°. The flame penetrated freely between the spheres for a distance of eight or ten feet from the bridge, and three-fourths of the whole evaporation probably took place within this distance. The spheres in the slabs at the back of the boiler were generally covered with a light coating of soot, which was swept off every week, all the spheres being within easy reach for this purpose; soot never formed, however, upon the spheres near the fire. The water level was very steadily maintained within a small range of oscillation, and as the feed water entered the boiler at the back, there could be no doubt, when it stood at its proper height in the glass gauge in front, that its level was properly maintained throughout the whole length of the boiler. A small cock, tapped into one of the steam spheres a short distance above the water level, showed damp steam, indicating a vigorous circulation of the water below; but in the engine room the steam blown from the cylinder cock was quite dry, showing the value of the superheating surface formed by the upper or steam spheres of the boiler.

In conclusion, it is considered by the writer that the boiler now described possesses several important advantages. It is believed to be absolutely secure from explosion, and, so far as experience has gone, free from any liability to choke with scale. It is durable, easily taken apart and put together, and may be erected in almost any form adapted to the space in which it is to be placed. The parts are very portable, and may be taken through any opening where a boy can pass. Any part of the boiler may be readily renewed if necessary; and an existing boiler may at any time be readily enlarged, and that to an indefinite extent, by adding to the number of slabs, either at the sides or at the back. The economy of the boiler in first cost is obvious; and with proper proportions between the fire-grate and the heating surface, as high an evaporative efficiency may be obtained as with most other constructions of boilers. The quantity of water contained in the boiler being comparatively small, steam may be raised with a small quantity of fuel and in a short space of time. Water may be left standing in the boiler for almost any length of time without injury. Every part of the boiler is at all times under ready observation, without disturbing the connections; and the outsides of the spheres may be easily swept. The setting of the boiler is such that the steam may

be dried to any extent desired in the spheres themselves, without any other provision for superheating. It is thought that this boiler especially meets the present increasing tendency to use high-pressure steam, and that the description now given will therefore prove interesting to this Institution.

The Chairman had seen the new boiler at work in Manchester, and considered it an important step towards the use of steam at a higher pressure than could at present be adopted. It was much more simple in construction than would at first sight appear; and with the facilities now possessed for multiplying parts of the same size and shape, he did not see any reason why it should not be put together easily and at a very small cost.

Scientific Adjudication.

COURT OF CHANCERY, LINCOLN'S INN.

January 14th, 1865.

(*Before the Lord Chancellor.*)

SIMPSON *v.* HOLLIDAY.

THIS was an appeal made on behalf of the defendant in a suit, against whom the judgment of Vice-Chancellor Sir W. P. Wood was given, July 15th, 1864,* in respect of the alleged infringement of a patent granted to Dr. Medlock, in January, 1860, for preparing red and purple dyes from aniline, and subsequently purchased by Messrs. Simpson, Maule, and Nicholson, manufacturing chemists. The main defence was, that the patent was bad in law, from the misdirection of the specificaiton, which, if interpreted by an ordinary workman, would lead him into error, both in respect of the materials to be used and the process to followed. On this head the Vice-Chancellor found, "that the specification sufficiently describes the invention."

In the contest before the Lord Chancellor, the same argument was followed, in respect of the construction of the specification, and the evidence adduced before the Vice-Chancellor was employed to enable the Lord Chancellor to put his interpretation on the specification. Following the admirable precedent which he had made in the case of Foxwell *v.* Bostock (sewing-machine case), he confined his attention to the construction of the specification, deferring his consideration of other points of the case until the objections raised to the validity of the patent had been disposed of.

The counsel engaged were—for the plaintiff, Sir Fitzroy Kelly, Mr. Grove, Mr. Bovill, Sir H. Cairns, Mr. Giffard, Mr. Drewry, and Mr. J. A. Russell; and for the defendant, now the appellant, Mr. Rolt, Mr. Hindmarch, Mr. Bevir, and Mr. Day.

The Lord Chancellor now gave judgment.

* For full report of this judgment, see Vol. XX., p. 105, New Series.

JUDGMENT.

The Lord Chancellor:—This case depends entirely on the construction and truth of the specification of the patent.

The first objection raised by the defendants is, that two processes for effecting the end proposed—one of which may be called the cold, and the other the hot process—are described in the specification; but that one of them, namely, the cold process, is ineffective. The plaintiff denies that two separate processes are described, if the specification be construed, as he contends it ought to be, in the manner most favourable to the patentee; but if there are two distinct processes described, yet as the specification states in effect that the desired result is obtained more quickly by the hot process, no one, as the plaintiff contends, would think of using the cold process, or be misled by it; and he further contends, that any workman of ordinary knowledge and observation would reject the cold process and adopt the hot. At the same time, the plaintiff admits that the cold process will not succeed, and is of no utility. If, therefore, the true construction of the specification be that two distinct processes are described as being both efficient, and are both claimed as part of the invention, but one is found upon trial to be inefficient and useless, it is plain that the patent has been granted on a false suggestion, and is, therefore invalid, and bad at law.

I cannot clearly discover, from the shorthand writer's note of the Vice-Chancellor's judgment, what were the grounds of His Honor's decision on this objection. If His Honor thought, of which there appears some indication, that the description of the cold process would do no harm, because the other process is described as quicker, and, therefore, that, as no one would be likely to resort to the cold process, the mention of it was harmless, and would not mislead, I cannot concur in any such legal conclusion. If a specification alleges that a particular process, which may be slow, troublesome, and expensive, is efficient, and the statement is untrue, the vice is not removed by the fact that the same specification also describes another process which is efficient, and which is stated to be speedy, certain, and economical. When it is said that an error in a specification, which any workman of ordinary skill and experience would perceive and correct, will not vitiate a patent, it must be understood of errors which appear on the face of the specification or the drawings it refers to, or which would be at once discovered and corrected in following out the instructions given for any process and manufacture; and the reason is, because such errors cannot possibly mislead. But that proposition is not a correct statement of the law, if applied to errors which are discoverable only by experiment and further inquiry. Neither is the proposition true of an erroneous statement in a specification, amounting to a false suggestion, even though the error would be at once observed by a workman possessed of ordinary knowledge of the subject.

With respect to the rules that govern the construction of specifications, they are the ordinary rules for the interpretation of written instruments, having regard especially to the fact, that the specification must clearly fulfil the obligation imposed on the patentee by the proviso

contained in all letters patent—namely, that the grant shall be void if the patentee shall not particularly describe and ascertain the nature of his invention, and in what manner the same is to be performed. It has, therefore, become a settled rule, that the specification must be so expressed as to be perfectly intelligible to a workman of ordinary knowledge; and it must follow that, if there be any obscurity or ambiguity in the specification, which is likely to mislead, this defect ought not to be helped by any refined or secondary interpretation of the language.

It was contended before me, and the Vice-Chancellor is reported to have said that it has been settled by authority, that the most liberal construction is to be given to a patent that will sustain it, especially in those cases where the court is satisfied that the invention is really new and useful. If the words, "the most liberal construction," are intended to denote some principle of interpretation different from the ordinary rules for the construction of written instruments, I am not aware of any such authority. The Vice-Chancellor is made to say that this liberal construction is especially adopted in cases where the court is satisfied that the invention is really new and useful; but novelty and utility are necessary for the validity of every patent. There is probably some inaccuracy in the note of the judgment. I concur in the remarks made by Mr. Baron Parke in his charge to the jury, in the case of Neilson *v.* Harford, in these words—"Within the last ten years or more, the courts have not been so strict in taking objections to specifications, and they have endeavoured to hold a fair hand between the patentee and the public—willing to give the patentee, on his part, the reward of a valuable patent, but taking care to secure to the public, on the other hand, the benefit of that proviso which is introduced into the patent for their advantage."

Coming, now, to the construction of this specification, the inquiry is, whether, according to the ordinary rules of interpretation, there is a distinct statement of two separate processes, which are both claimed as inventions? The question depends on the construction of the first sentence in the specification; and the inquiry seems to be, whether the words, "until it assumes a rich purple color," apply to both the antecedent members of the sentence, so as to involve a statement—that if the mixture of aniline with dry arsenic acid be allowed to stand for some time without the application of heat, it will assume a rich purple color; but that the operation—that is, the obtaining a rich purple color—may be accelerated by heat: and I am unable to manage the words in any way so as to arrive at a different interpretation. It seems impossible, without rejecting several words and altering the form of the whole sentence, to make it descriptive of one process only—namely, that in which the operation is accelerated by heating the mixture.

Two modes of treating aniline with arsenic acid are plainly indicated,—one, the cold and slower process; and the other, the application of a very considerable degree of heat, so as to bring the mixture to or near to the boiling point of aniline. Both these processes enter into and form the claim of the patentee, which is for the manufacture or preparation of red and purple dyes by treating aniline with arsenic acid in the manner hereinbefore described — that is, either by the cold or the hot process.

It was argued before me that the word "or," in the words, "or I accelerate the operation," should be read, "and" a construction, which is forbidden by the whole structure of the sentence. And it was further contended that the subsequent sentence, which begins with the words, "The mixture of aniline and arsenic acid after being heated," proved that one process only—namely, the hot process—was intended to be described and used, and that it corrected the alternative form of expression in the first sentence. But this is not the case; for the sentence in question applies only to the paste which is formed by the hot process,—if the mixture, after being heated as directed, is allowed to cool before it is treated with hot water, in the manner described.

It was urged that every person well informed on the subject would see that the cold process was ineffective. But this is to correct the specification by the superior intelligence of the reader; and is a mode of proving the invalidity of the patent, by showing the false suggestion on which it was granted. It was frankly and rightly admitted by the plaintiff's counsel, during the argument before the Vice-Chancellor and also before me, that, if the specification contained a separate and distinct description of a cold process, as well as of a hot process, the patent must be held to be void, because the cold process would not succeed; and, as I am clearly of opinion that there is a description and claim of these two processes in the specification, as constituting the invention, I am obliged to pronounce the patent invalid.

Although my decision rests on the ground I have stated, yet, as the case may be carried to the House of Lords, it would be wrong to omit all notice of the other objection of the defendant, and which, in fact, formed the principal subject of evidence and argument. This objection is founded on the direction contained in the specification—to take "dry" arsenic acid." "*Dry*," says the defendant, "is synonomous with *anhydrous*." The one is the popular, the other the chemical equivalent, term. All arsenic acid, according to the formulæ for its preparation, contained in different pharmacopœiæ, is anhydrous; but, in fact, it is seldom, if ever, so prepared as to cease to be, to a certain extent, hydrated. According to the most accurate experiments of the French chemist, Kopp —whose work was given in evidence—it would seem that arsenic acid, if heated to a red heat, throws off all its water of hydration, but, at the same time, becomes an arseniate, and ceases to be an acid. According to the degree of heat to which it is subjected, it retains more or less of water of hydration. From the evidence, it would seem that arsenic acid, as an article of commerce at the time when this patent was granted, was usually so prepared as that, when sold, it was found to contain from 12 to 15 or 16 per cent. of water of hydration; and the defendants insist that the patentee must be considered to have known this fact, and, therefore, to have used the adjective "dry" to denote that it must be "anhydrous" in a greater degree than was usually the case with arsenic acid of commerce.

It further appears, from the evidence, that no good result could be obtained from using, in the manner directed by the patent, arsenic acid that contained less than 12 or 14 per cent. of water of hydration; but there is some evidence to show that, with that quantity of water of hydration, a beneficial result would be obtained The defendants, therefore, insist that the effect of the direction, to take dry arsenic

acid, would naturally be to mislead the workman using the patent, and induce him to believe that the imperfect results obtained from the ordinary arsenic acid were attributable to its not being sufficiently anhydrous; and thus he would be led away in a direction opposite to that in which the true practical discovery lies, and which is, probably, embodied in the subsequent patent of De Laire and Girard, granted in 1860. On the contrary, the plaintiffs insist that "dry arsenic acid" was, at the time of the patent, the well-known denomination of commercial arsenic acid—which means that it was commonly bought and sold under that name. The Vice-Chancellor appears to have been of this opinion, but I cannot find any evidence that arsenic acid was, at the time of the patent, ever labelled, sold, or invoiced under the name of "dry arsenic acid." On the contrary, there is some evidence that if the article had been asked for under the name of dry arsenic acid, the seller would not have undertaken to sell it as answering that description.

Upon a review of the arguments and the evidence, I cannot, on this point, accept the contention of either side. "Dry" is not synonomous with "anhydrous." When used in its ordinary sense, as opposed to "wet," it means physically dry, or dry to the touch; and many things are dry superficially to the touch, which contain a great deal of water of combination. Now, it is a property of arsenic acid, that it readily imbibes moisture from the atmosphere, and becomes deliquescent; but when in a state of deliquescence, it is moist and clammy to the touch, and would not be solid or physically dry. In putting a construction, therefore, on this part of the specification, I do not attribute to the word "dry" the technical scientific meaning of anhydrous, but take it in its ordinary and popular meaning of dry to the touch, or dry externally, and which makes the passage amount to a direction to take the powder of the arsenic acid in a solid or physically dry condition—and not in a state of deliquescence. The plaintiff, Nicholson, states in his evidence, that the word dry was used in order that the proper proportion of acid might be more readily ascertained, and he, therefore, construes the words as meaning physically dry. It is true that the direction resulting from this construction of the word "dry" will be of no use, but rather the contrary, in the profitable working of the invention; but, inasmuch as I have already found it proved, that the ordinary arsenic acid of commerce, when used in the state of a dry powder, in which it was and is commonly sold, would produce a beneficial result, this addition of the word "dry" would not affect the working of the patent. I should not, therefore, have been of opinion that this objection was fatal to the patent, but the other objection I hold to be fatal.

I must, therefore, reverse the order of the Vice-Chancellor, and, with some reluctance, pronounce the patent to be bad and void in law.

Cases of this nature frequently give rise to complaints of the state of the law. It is, therefore, right to point out how entirely the plaintiff's failure has arisen from not availing himself of the salutary provisions of the existing statutes. The provisional specification proves that a valuable discovery had been partially made, but not matured: and that the true conditions on which it might become an invention of practical utility had not been ascertained. Six months are allowed by the law for maturing the invention and accurately ascertaining and stating it;

but in this case there does not appear to have been any attempt by the patentee to improve his knowledge; for the complete specification is a mere repetition of the provisional. Lastly, the inefficiency of the cold process, and the dangerous language of the specification, must have been known long prior to this suit, and yet there was no attempt to remove the objection, as might easily have been done by a disclaimer under the statutes.

Reverse the order of the Vice-Chancellor; dissolve the injunction; declare that this court doth find and determine that the patent is bad and void in law; let the costs before the Vice-Chancellor and of this hearing be costs in the cause; let the cause be transferred from the Vice-Chancellor's paper to me, and be heard before me on all that remains to be disposed of on the first day of my sitting after the present term.

SIR FITZROY KELLY:—May I be permitted to ask, does your lordship dispose of the particular issues?

The LORD CHANCELLOR:—I am very sorry, Sir Fitzroy Kelly, to have found that cumbrous and inconvenient practice introduced into this court. I should have very much preferred a practice which now, with the experience of five or six cases of great importance and great weight, has uniformly been found to be the only thing required—namely, first to determine the validity of the specification. It is quite an idle thing to go into the issues of want of novelty and infringement, and the other issues which, following the example at law, have here been raised. I find, therefore, generally that the patent is void at law. On that will follow, perhaps, an order, dismissing the bill entirely. That must be the subject of an ulterior application, and it is for that reason I direct it to be in the paper.

Provisional Protections Granted.

[*Cases in which a Full Specification has been deposited.*]

1864.

3099. George Washington Belding, of Cheapside, and David Emory Holman, of Sloane-street, impts. in machinery designed for shaping and pressing straw hats, bonnets, and other articles,—a communication.—*December 14th.*

3215. William Edward Gedge, of Wellington-street, impd. apparatus for administering douches and injections with continuous and continual jet,—a communication.—*December 27th.*

1865.

54. Horatio Ames, of Connecticut, U.S.A., impd. method of constructing ordnance or cannon of wrought-iron.—*January 6th.*

Cases in which a Provisional Specification has been deposited.

1864.

2062. Frederich Kreuz, of Barmen, Prussia, impts. in the manufacture of crinolines, dresses, mantles, and other such like articles of wearing apparel.—*August 19th.*

2082. George Parsons, of Martock, Somersetshire, impts. in machines for seeding and breaking flax.—*August 23rd.*

2160. Margaret Barland, of Mount-

street, Grosvenor-square, impts. in obtaining motive power, and in applying the same to the propulsion of ships or vessels constructed therefor, and to other useful purposes,—a communication.—*September 2nd.*

2164. Charles William Standish, of King's-road, Chelsea, impd. apparatus for boiling eggs.—*September 3rd.*

2179. John Smith, of Nottingham, impts. in saving ships or other vessels from sinking.—*September 6th.*

2195. George Bedson, of Manchester, impts. in machinery or apparatus for rolling wire rods and wire.—*September 8th.*

2582. Washington Michael Ryer, of Paris, impts. in iron-clad vessels, and other apparatus for conveying and exploding submarine explosives. —*October 19th.*

2605. Laurent Paviola, of La Ciotat, France, impd. anti-saline coating, chiefly applicable for preserving from corrosion and incrustation the boilers and pipes of marine steam engines.—*October 21st.*

2655. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in the manufacture of spectacle frames, and in the machinery employed therein,—a communication.—*October 26th.*

2684. Bezer Richmond Keith, of Ingram-court, Fenchurch-street, article of farinaceous food,—a communication.—*October 29th.*

2745. Henry Valentine Scattergood, of Albany, U.S.A., impts. in cotton gins.—*November 5th.*

2788. James Alexander Manning, of the Inner Temple, impts. in the collection and treatment of night soil.—*November 10th.*

2808. William Edward Gedge, of Wellington-street, impd. sanatory toilet apparatus,—a communication.—*November 11th.*

2863. William Edward Newton, of Chancery-lane, impts. in printing machinery,—a communication.—*November 16th.*

2869. Robert Green Grimes, of St. George-street, impts. in the construction and arrangement of the works and cases of beer engines.—*November 17th.*

2892. John Garrett Tongue, of Southampton-buildings, impts. in fire-arms, and in cartridges for the same; also in the mode of mounting bayonets thereon,—a communication.—*November 19th.*

2912. Jacob Snider, jun., of Sullivan County, Pennsylvania, U.S.A., impts. in breech-loading fire-arms.—*November 22nd.*

2920. Gustave Maillard de Bayelt and Joseph Emile Vigoulète, of Nelson-square, impd. method of compounding, by agglomeration, artificial fuel. —*November 23rd.*

2933. James Eastwood, of Blackburn, and William Wadsworth, of Manchester, impd. means or method of, and apparatus to be employed for, "finishing" cotton pieces in the gray.

2943. Richard Archibald Brooman, of Fleet-street, impd. lighting composition, and an impd. apparatus for lighting, together with the employment of pyrophorous materials for the lighting of cigars, pipes, and other articles,—a communication.

The above bear date November 24th.

2954. Alfred Vincent Newton, of Chancery-lane, impts. in hasp locks,—a communication.—*November 25th.*

2966. John Henry Johnson, of Lincoln's-inn-fields, impts. in the mode of, and apparatus for, stopping bottles,—a communication.

2967. Samuel Solomon Maurice, of Watling-street, impt. in collars for the neck,—a communication.

The above bear date November 28th.

2974. Vincent Gàche, of Nantes, France, impd. system of paving,—*November 29th.*

2982. Edmund Winder Otway, of Reading, impts. in machinery for ginning or cleaning cotton.—*November 30th.*

2993. John Soper, of Mornington-road, St. Pancras, impts. in the means of raising and lowering weights, applicable to Venetian blinds, curtains, and other purposes.

2995. Thomas Harris, of Calne, Wiltshire, impd. method of constructing rooms or places for curing and preserving meat or other perishable articles,—a communication.

2996. Jacob Taylor, of Oldham, impts. in propellers for ships and vessels.
2997. Julius Sax, of Great Russell-street, impt. of electric fire buttons and indicators, capable of being used in private houses, public places, on board ships, and on railways.
2998. Christopher Binks, of Paris, impts. in separating sulphur from coal and coke.
2999. Joseph Neat, of Southampton, impd. mechanical hair brush.
3000. Frederick Charles Rein, of the Strand, impd. apparatus by the use of which any sound will become inaudible to the wearer.
3001. Thomas Wilson, of Birmingham, impts. in breech-loading fire-arms, and in cartridges for fire-arms and ordnance.
3002. Charles Smith, of Brinscombe, Gloucestershire, and William Fletcher, of Bath, impts. in casks.

The above bear date December 1st.

3004. Samuel Parker Kittle, of Brooklyn, New York, U.S.A., impts. in folding spring mattresses.
3006. William Clark, of Chancery-lane, impts. in the means and apparatus employed for actuating railway brakes,—a communication.
3008. William Pollock, of Glasgow, impts. in the manufacture of textile fabrics, and in the machinery or apparatus connected therewith.

The above bear date December 2nd.

3010. Edward Bevan, of Birkenhead, and Abel Fleming, of Liverpool, impt. in the construction of bottles, jars, and like vessels of capacity, and impd. means for securing or fastening corks and other stoppers therein.
3012. John Kennedy Crawford, of Glasgow, impts. in producing ornamental fabrics.
3014. Richard Archibald Brooman, of Fleet-street, impd. comb or ornament for the back of the heads of ladies,—a communication.
3016. John William Proffitt, of Lincoln's-inn-fields, impts. in railway carriage and passenger signals.
3017. John Gottlieb Ulrich, of Wellclose-square, impts. in the means and contrivances employed in the packing, conveying, and storing of gunpowder and other explosive materials, to prevent the accidental explosion thereof.
3018. Charles William Siemens, of Great George-street, impts. in apparatus for the production, purification, and combustion of gases for heating purposes.

The above bear date December 3rd.

3020. John Gano Winter, of Chester, impts. in revolving retorts, and in the mode of applying heat to the same; designed for producing oil from coals, shales, cannels, and other substances, or for distilling oils.
3021. Henry Wilson, of Stockton-upon-Tees, impts. in pumps.
3022. Richard Tye, of Birmingham, impts. in sliding gasaliers, gas pendants, and gas lamps.
3024. Richard Shaw, of Patricroft, impd. arrangements for locking and unlocking the doors of railway carriages.
3026. William Clark, of Chancery-lane, impts. in fire-arms, cartridges, and cannon, and in an impd. method of fixing the bayonets of fire-arms,—a communication.
3028. William Edward Newton, of Chancery-lane, impts. in hand stamps,—a communication.

The above bear date December 5th.

3030. Thomas Atkins, of Fleet-street, combining apparatus used for regulating, adjusting, and indicating the supply and flow of hydro-carbon and other gases and vapours with impd. apparatus for effecting the perfect carburation and purification of such gases and vapours, for illuminating and other purposes; and for impts. in the construction of the apparatus for effecting the same.
3032. Alexandre Blampoil, of Paris, impd. smoke-consuming apparatus, applicable to the boilers of locomotives and stationary engines.
3034. William Edward Gedge, of Wellington-street, belt and impd. sanatory apparatus for female use,—a communication.
3036. George Dixon, of the City, impts. in the manufacture of ruche for chenille and upholsterers' trimmings.

3038. Thomas Archer, jun., of Gateshead-on-Tyne, impd. machine or apparatus for crushing or breaking stone, ores, or other similar hard substances.
3040. Arthur Henry Robinson, of Dublin, combined stretcher-bed, cushion, and wrapper, for use in railway and other travelling carriages.
3041. William Clark, of Chancery-lane, impts. in apparatus for the manufacture of boots and shoes,—a communication.
3044. Matthew Piers Watt Boulton, of Tew-park, Oxfordshire, impts. in obtaining motive power from aeriform fluids and from liquids.
3045. Edward Thomas Hughes, of Chancery-lane, impts. in treating aniline colors for dyeing and printing,—a communication.
3046. Richard Richardson, of Lowdham, Nottinghamshire, impts. in the manufacture of felt.

The above bear date December 6th.

3050. Albert Surflen, of South-crescent, Bedford-square, impd. washing and scrubbing compound.
3051. Alfred Albert, of Paris, impd. stamping apparatus.
3052. William Husband, of Hayle, Cornwall, and Joseph Quick, jun., of Sumner-street, Southwark, impts. in steam boilers.
3053. Martyn John Roberts, of Pendarren, Brecknockshire, impts. in means or apparatus for preparing, spinning, doubling, and winding wool, cotton, and other fibrous substances.
3054. Andrew Smith, of Mauchline, Ayrshire, N.B., decorating japanned ware and articles of furniture with paper or other material, printed or ornamented in various colors.

The above bear date December 7th.

3056. Henry Wilson, of Stockton-upon-Tees, impts. in apparatus for injecting tallow or other lubricant into steam boilers, cylinders, and steam-tight vessels; likewise for regulating the flow thereof.
3057. Charles Oliver, of Old Boswell-court, impts. in apparatus for sounding bells on lighthouses, alarm bells on public and private buildings, and for bells in chapels and places of worship.
3058. John Norton, of Bray, Wicklow, Ireland, impts. in the construction of bows used by archers.
3059. Edward Myers, of Millbank-row, Westminster, impts. in wet gas meters.
3060. Charles Crockford, of Holywell, Flintshire, impts. in traction on railways, more especially adapted to steep gradients.
3062. Richard Archibald Brooman, of Fleet-street, impts. in apparatus for cooling and freezing,—a communication.

The above bear date December 8th.

3064. John Henry Johnson, of Lincoln's-inn-fields, impts. in apparatus for facilitating the starting of railway and other carriages and waggons,—a communication.
3066. Thomas Humphrey Roberts, of Plymouth, impts. in apparatus for retarding and stopping carriages.

The above bear date December 9th.

3067. John Holly, of Regent-street North, Blackwall, impd. mechanical arrangements or appliances for enabling the guard of a railway train to keep all the carriage doors closed until the train is brought to a stand-still, and then disengage them all at once.
3069. Angelo James Sedley, of Conduit-street, impts. in construction of bridges.
3070. Lazarus Morgenthau, of Basinghall-street, impts. in preparing tobacco for the manufacture of cigars, snuff, and other purposes.
3071. John Vaughan, of the Middlesbro' and Cleveland Iron Works, Yorkshire, impts. in heating the blast for furnaces in the manufacture of iron.

The above bear date December 10th.

3072. George Rooper, of Lincoln's-inn-fields, impts. in cross-cut and other saws,—a communication.
3073. John Ramsbottom, of Crewe, impts. in the manufacture of steel and iron, and in the apparatus employed therein.
3074. Thomas Wood, of Liverpool,

impts. in means or apparatus for communicating and signalling on railway trains, and for securing the doors of the carriages.

3075. Edward Brooke the younger, of Huddersfield, impt. in the manufacture of glass-house pots.

3076. Richard Archibald Brooman, of Fleet-street, method of ornamenting fabrics,—a communication.

3077. Alexander Moncrieff, of Edinburgh, impts. in mounting ordnance, and in the machinery, apparatus, or means connected therewith.

3078. Robert Mathers, of Leeds, impts. in sawing machinery.

The above bear date December 12th.

3080. Frederick George Mulholland, of Essex-street, Strand, impts. in purifying rosin or other substances of a similar kind and character.

3081. William Bridges Adams, of Holly-mount, Hampstead, impts. in railways and tramways.

3082. Richard Helsby Johnson, of Eccleston, Lancashire, impts. in the construction of glass-makers' "pots," and in the application of heat to the materials or glass "metal" contained therein.

3083. Charles Kendall, of High-street, Whitechapel, impts. in atmospheric railway breaks and communications.

3084. Richard Archibald Brooman, of Fleet-street, impts. in, or a new or impd. composition for, preserving and ornamenting stone, wood, and other substances,—a communication.

3085. Arthur Brittlebank, of Boziers-court, Tottenham-court-road, impts. in apparatus used when brushing the human hair.

3086. William Henry Cullingford, of Phillimore - gardens, Kensington, impts. in thermometers.

3087. Alfred Pemberton, of Eccles, and John Ford, of Salford, impts. in apparatus for effecting the drag in throstle spinning and doubling.

3088. Alfred Vincent Newton, of Chancery-lane, impts. in solar time-pieces, —a communication.

3089. George Elliott, of Hull, impd. means of, and apparatus for, working capstans on ship board and elsewhere.

The above bear date December 13th.

3090. Edmund Winder Otway, of Reading, impts. in roller gins for ginning or cleaning cotton,

3091. Joseph Barnsley, of Hales Owen, Worcestershire, impts. in the manufacture of solid and seamless metal tubes, gun barrels, and artillery, and for machinery to be used in the same.

3092. Charles Hancock, of West-street, Smithfield, and Stephen William Silver, of Bishopsgate-street, impts. in electric insulation.

3093. Charles Hancock, of West-street, Smithfield, and Stephen William Silver, of Bishopsgate-street, impts. in color printing.

3094. Charles Hancock, of West-street, Smithfield, and Stephen William Silver, of Bishopsgate-street, manufacture of sheets and surfaces for designs and ornamental purposes.

3095. Jacob Baynes Thompson, of Rothwell-street, Regent's-park-road, impts. in coating iron and steel with silver, gold, platinum, or palladium; and in ornamenting articles with such metals.

3096. Herbert Taylor, of Mark-lane, impts. in the manufacture of ruffles, frills, and gathered fabrics, and in the machinery or apparatus employed therein,—acommmunication.

3097. Joseph Crowley, of West Bromwich, impts. in moulds for casting hollow ware and other articles.

3098. William Wharldall, of Pontefract, impd. machinery or apparatus for the manufacture of liquorice cakes; applicable also to the manufacture of other cakes or lozenges made of plastic materials.

3100. John Garrett Tongue, of Southampton-buildings, impts. in the construction of watches or other similar time-keepers,—a communication.

3101. Peter Frederick Lunde, of Jewry-street, Aldgate, impd. apparatus for obtaining extracts from vegetable substances.

3102. Astley Paston Price, of Lincoln's-inn-fields, impts. in obtaining carbonic acid gas.

3103. Cowper Phipps Coles, of Ventnor, Isle of Wight, impts. in apparatus for working and loading ordnance.

3104. Samuel Hood, of King William-street, impd. method of securing

coal plates, applicable to the securing of glazed area gratings, trap doors, and other similar covers.

3105. James Leeming, John Leeming, and John Lister, of Bradford, impts. in the Jacquard machine.

3106. George Kent, of High Holborn, impts. in apparatus for cleaning and polishing knives.

3107. Antoine François Jean Claudet, of Gloucester-road, Regent's-park, impts. in photo-sculpture.

The above bear date December 14th.

3108. John Anthony Pols, of Nye's Wharf, Old Kent-road, impts. in obtaining purified or refined oils, and in obtaining oil cakes for cattle food and foots useful for soap making.

3109. Alexander Richard Croucher, of Wellclose-square, impts. in apparatus for facilitating communication between passengers and guards travelling on railways.

3110. Charles Hancock, of West-street, Smithfield, and Stephen William Silver, of Bishopsgate-street, manufacture of certain flexible elastic waterproof sheets, surfaces, compounds, and substances, and the application thereof to various purposes.

3111. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in the manufacture of gun barrels,—a communication.

3112. Stephen Pettit, of Canterbury, impts. in engines or apparatus for obtaining motive power.

3113. William Clark, of Chancery-lane, impts. in the decoration of walls, pavements, and other surfaces in cement, concrete, and other substances, a communication.

The above bear date December 15th.

3114. William Edward Gedge, of Wellington-street, impts. in steam engines,—a communication.

3116. John Ellis, of North Ormesby, near Middlesborough-on-Tees, impts. in furnaces used in the manufacture and the heating and melting of iron; which impts. are also applicable to other furnaces.

3117. Stephen Wastel Hooper, of Fleet-street, impts. in the preparation of the surface or surfaces of parchment.

3118. Richard Archibald Brooman, of Fleet-street, impts. in machinery for decorticating or for separating the kernel from the shell of cotton seeds,—a communication.

3119. François Auguste Chevallier, of Paris, impts. in panoramic apparatus.

3120. George Brown, of Poole, Dorsetshire, impt. in the construction of cylinders used in the manufacture of articles of pottery, such as pipes, tiles, hollow bricks, and the like.

3121. James White, of Dorchester, impts. in closets and commodes.

3122. William McNaught, of Rochdale, impts. in machinery for washing and drying wool and other fibrous materials.

3123. William Cotton, of Loughborough, impts. in machinery or apparatus for the manufacture of looped fabrics.

3124. Arthur Henry Robinson, of Dublin, impd. portable bedstead.

3125. Michael John Haines, of Bristol, impts. in the construction of straps or bands employed for driving machinery.

3126. James Lee Norton, of Belle Sauvage-yard, London, and William Ainsworth, of Stockport, impts. in looms for weaving.

The above bear date December 16th.

3127. John Garrett Tongue, of Southampton-buildings, impts. in pneumatic apparatus for raising and drawing off liquids and gases,—a communication.

3129. Frederick Cooke, of Denton, Lancashire, impts. in machinery or apparatus to be employed in the manufacture of hats or similar coverings for the head.

3130. Benjamin Dobson, William Slater, and Robert Halliwell, of Bolton, impts. in self-acting mules for spinning and doubling.

3132. Amherst Hawker Renton, of Whitehall, impts. in fire-arms.

3134. Richard Archibald Brooman, of Fleet-street, impd. liquid meter,—a communication.

3135. Frederick Price, of Gresford, Denbighshire, impts. applicable to mills for grinding corn and other substances.

3136. Hiram Lyman Hall, of West Ham,

impts. in the manufacture of elastic fabrics.

3137. Zebina Eastman, of Bristol, impts. in rails or trams for street and other roads or ways, in wheels to run thereon, and in the working parts of carriages or waggons to be used therewith.

3138. Walter Howes and William Burley, of Birmingham, impts. in lamps for railway and other carriages, and in connecting lamps to carriages; a part of which impts. may also be applied to handles for carriages.

3139. Henry Davey, of Gunnislake, Cornwall, impts. in steam engines.

The above bear date December 17th.

3141. John Arthur Hopkins and Charles Culpin, of St. Ives, impts. in ploughs and apparatus for tilling the soil.

3142. William Tate, of Horsley-hill, near South Shields, impts. in armour, and in making and applying the same for protecting wood and iron ships of war and batteries.

3144. Ernest Swinarski, of Kreuszewo, Prussia, impts. in breech-loading fire-arms.

3145. Charles Wyatt Orford, of Birmingham, impd. apparatus for measuring water and other fluids.

3146. Sir John Gray, of Charlerille House, Dublin, impd. taps or cocks for regulating the flow of water into, through, or from, cisterns, pipes, and other receptacles or conduits.

3147. Henry Frederick McKillop, of Belvedere, Kent, impts. in compositions for coating or covering ships.

3148. Richard Archibald Brooman, of Fleet-street, impts. in furnaces,—a communication.

3149. Sir Francis Blackwood, of Southsea, impd. apparatus for elevating or lifting shot or shell to the fighting deck of vessels or in batteries of war.

3150. John Butchart, Henry Stroud, and Samuel Allen Morrison, of North Shields, impts. in reefing and stowing jib sails from the deck.

3151. Edward Thomas Hughes, of Chancery-lane, impts. in machinery or apparatus for making laces, braids, cordings, and edges,—a communication.

3152. Henry James Hogg King, of Cain's Cross, Stroud, Hubert Ellis Smith, of Upton Bishop, Herefordshire, and Joseph Bennett Howell, of Sheffield, impts. in the slide valves of steam engines, and in apparatus connected with or operating the slide valves of steam engines.

The above bear date December 19th.

3153. David Millar, of Greenock, impts. in apparatus for moving heavy bodies.

3154. William Edward Gedge, of Wellington-street, impd. box for preserving velvets, ribands, and similar articles,—a communication.

3155. Henri Druneau and Pierre Laidet, of Nantes, France, impd. double suction pump, suitable for pumping bilge water out of ships.

3156. Simon Erastus Pettee, of St. Mary's-terrace, Paddington, impts. in means or apparatus for signalling between passengers and guards or others in charge of railway trains.

3157. Peter Cameron, of Paisley, and Thomas Bowman, of Glasgow, impts. in textile fabrics, and in the machinery or apparatus employed for producing the same.

3158. George Leach, of Leeds, impd. fastening for books, pocket-books, portfolios, satchels, bags, writing cases, and other analogous articles.

3159. Thomas Augustin Grimston, of Clifford, Yorkshire, impd. apparatus to be used with breech-loading fire-arms, so as to render them available for use as breech-loaders or muzzle-loaders, as may be found convenient.

3160. Henry Bird, of Cheltenham, impts. in treating sewage matters.

3161. Stephen Pierre André de Brocalde d'Elüza, of Leicester-square, impd. manufacture of artificial manure.

3162. William Maynes, of Levenshulme, near Manchester, impd. picker band used in looms for weaving.

3163. José Puig y Llagostera, of the Strand, impts. in machinery for spinning cotton and other fibrous materials,—a communication.

The above bear date December 20th.

3164. Henry Alfred De Brion, jun., of Welbeck-street, impd. varnish for protecting and preserving metals, such as polished steel, silver plate,

silver-plated and electro-plated articles, from oxidation, corrosion, and from the effects of damp or the action of sulphuretted hydrogen, and improved liquids for cleaning and brightening said articles.

3166. Joseph Westwood, jun., of Bow, impts. in iron bridges.

3167. Charles Edward Bryant and Samuel Middleton, of Greek-street, Soho, impd. mechanical apparatus for brushing the hair.

3168. Charles Grey Hill, of Nottingham, impts. in machinery or apparatus employed in the manufacture of bonnet and cap fronts, rouches, and millinery or other trimmings, and in the manufacture and production of the same.

3169. Michael Henry, of Fleet-street, impts. in governors,—a communication.

3170. Frederick Tolhausen, of Paris, impd. method of aggregating coal-dust,—a communication.

3171. John Ramsbottom and Thomas Blackburn, of Blackburn, impts. in the construction of hydraulic and other engines for obtaining motive power, and for compressing and measuring fluids.

3172. John William Cowles Brewer, of King's Holm, Gloucestershire, and William Warren, of Cheltenham, impd. apparatus for facilitating communication by signals between different parts of a railway train; parts of which apparatus are also applicable to other purposes.

3173. Louis Rudolph Bodmer, of Thavies'-inn, impts. in the mode of working hydraulic presses, cranes, lifts, and other machinery and apparatus actuated by water pressure, and in machinery and apparatus connected therewith,—a communication.

3175. John Henry Johnson, of Lincoln's-inn-fields, impts. in photographic apparatus,—a communication.

3176. James Hargreaves, of Ashton-under-Lyne, impts. in looms for weaving.

The above bear date December 21st.

3178. Henry Edmonds, of Gosport, impts. in the construction of lamp feeders and other vessels from which fluid is poured out through tubular spouts.

3180. Jonathan Grundy Aram, of Bradford, impd. mode of lighting household and other fires.

3181. Charles George Wilson, of Gracechurch-street, impts. in machinery for pressing cotton or other elastic substances.

3182. James Byrne, of Dublin, impts. in governors.

3184. Robert Luke Howard, of Upper Whitecross-street, and John Daughlish, of Reading, impts. in apparatus for making aërated bread.

3185. James Gillespie, of Garnkirk, Lanarkshire, impd. construction and manufacture of retorts, crucibles, glasshouse pots, and other similar vessels, and in the means and apparatus employed therein.

The above bear date December 22nd.

3186. James Broughton Edge and Enoch Hird, of Bolton, impd. size or adhesive mixture to be used in the process of finishing cotton heald and other double yarns, and in the machinery or apparatus employed therein.

3187. Thomas Pinfold Hawkins, of Birmingham, impts. in fencing and other staples.

3188. George Haseltine, of Southampton-buildings, impts. in machinery for manufacturing metallic nuts,—a communication.

3189. Emile Taconet, of Paris, impts. in looms, by the addition of one or more reeds to the ordinary reed, to facilitate the division of the warp during the weaving.

3191. James Paterson, of Dundee, N.B., impts. in the treatment of jute and other fibrous substances, and in the machinery, apparatus, or means connected therewith.

3192. John Bethell, of King William-Street, impts. in preserving wood.

3193. John Francis Wheeler, of Ryde, Isle of Wight, impd. combined portable inkstand, pen, and pencil holder.

3194. Thomas Fagg and Jesse Fagg, of Panton-street, impts. in the manufacture of boots and shoes.

3195. Richard Archibald Brooman, of Fleet-street, impts. in coke ovens,—a communication.

3196. Richard Archibald Brooman, of Fleet-street, impts. in portable

fire-arms and in cartridges,—a communication.

3197. Edward Saunders, of Bridge-street, Westminster, impts. in affixing armour plates to vessels and other structures, and in bolts, screws, spikes, and rivets, to be used for these and other purposes,—a communication.

3198. Lord John Hay, of St. James's-place, impts. in autograph stamps, and in apparatus connected therewith; parts of which apparatus may be employed for numbering.

The above bear date December 23rd.

3199. William Henry Maitland, of the City of London, impts. in the construction of cotton gins.

3200. Enoch Fielding, of Todmorden, impts. in power looms and apparatus connected therewith.

3201. Charles Ross Bamber, of Jersey, impd. signalling or communicating apparatus for railway carriages.

3202. Edmund Leahy, of Langford-road, Kentish Town, impts. in the construction and fitting of railway wheels.

3203. Benedict Margulies and John Knowles Leather, of St. Helen's, Lancashire, impts. in the manufacture of chromates and bichromates.

3204. John Rowberry, of Hereford, impd. centrifugal drying machine.

3205. Alfred Vincent Newton, of Chancery-lane, impd. means for stopping leaks in boiler tubes,—a communication.

3206. Thomas Robinson, of Sheffield, impts. in tea pots, coffee pots, claret, hot water, and other jugs, having metallic covers.

3207. Edmund Morewood, of Cheam, Surrey, impts. in coating metals.

3208. Charles Henry Taylor, of Birmingham, impts. in machinery or apparatus for preventing accidents in mine shafts, and for other like purposes.

3209. James Hill Cheatle, of Birmingham, impts. in rotary and other brushes.

3210. Thomas Whitley, of Birstal, Yorkshire, and Jonas Jowett, of Bradford, impts. in machinery used in combing wool and other fibrous materials.

3211. James Peter Robinson, impd. connector, applicable to bales used in cavalry stables and other purposes.

The above bear date December 24th.

3212. John Parkinson, of Bury, Lancashire, impts. in lamps for railway carriages.

3213. John Wolstenholme, of Ratcliffe, Lancashire, impd. implement for cutting pipes and bars of metal.

The above bear date December 26th.

3214. Henry Hicklin, of Wollaston, near Stourbridge, and Charles Pardoe, of Brierley-hill, Staffordshire, impts. in the construction of coke ovens.

3216. George Alton, of Derby, impd. machinery for flanging plates and strips of metal.

3217. George Alton, of Derby, method of, and machinery for, curving flanged boiler and other metal plates.

3218. William Buttrum, of Swilland, Suffolk, impts. in the means of signalling between the passengers and the guard and driver of railway trains.

The above bear date December 27th.

3219. James Dodge, of Manchester, impts. in apparatus for rolling, shaping, and forging "file-blanks," "flyers," and other metallic articles of small dimensions.

3220. Henry Johnson, of Birmingham, impts. in the manufacture of top notches and runners for umbrellas and parasols.

3221. John Cleaver, of Canterbury-place, Walworth, impts. in the manufacture of Portland cement.

3222. John Robert Breckon, of Darlington, and Robert Dixon, of Crook, Durham, impts. in the construction of coke ovens.

3223. Aristide Paul Blanchet, of Paris, impts. in the application of steam-power to the cultivation of land.

3224. Joseph Bardies, of Paris, impts. in the manufacture of pianos.

3225. John Thornton and William Thornton, of Nottingham, impts. in machinery for producing looped fabrics.

3226. William Holmes, of Glasgow, impts. in the mode of treating

warped yarns used for weaving, and in the machinery or apparatus connected therewith.

3227. William Henry Preece and Alfred Bedborough, of Southampton, impd. apparatus for signalling in railway trains.

The above bear date December 28th.

3228. Robert Henry Lease, of New York, machinery for cutting at one operation dovetail and mitre joints, —a communication.

3229. James Darsie Morrison, of Edinburgh, impts. in painless dentistry, by apparatus for cooling and tempering air and applying it as an anæsthetic agent.

3230. George Edwards, of Park-road-villas, Battersea, impts. in pneumatic apparatus for raising materials and other purposes.

3231. Douglas Sutherland, of Great George-street, Westminster, impts. in preparing charges for, and in charging, ordnance.

3232. James Millar, of Sterling, N.B., impts. in locomotive steam engines, and in part applicable to other engines.

3233. Matthew Andrew Muir and James Mc Ilwham, of Glasgow, impts. in and relating to fastenings for railways.

3234. Joseph Truswell and William Truswell, of Sheffield, impd. float, for indicating the level of the water in steam boilers.

3237. John Dodd, of Oldham, impts. in mules for spinning and doubling.

3238. John Henry Johnson, of Lincoln's-inn-fields, impts. in sewing machines,—a communication.

3239. William Nalder and Alfred Belcher, of East Challow, Berks, impts. in steam engines and apparatus connected therewith, and with steam boilers; parts of which impts. are applicable to machinery in general.

3240. Richard Cail, of Gateshead, impts. in projectiles.

3241. Pierre Charles Paul Laurent Préfontaine, of Paris, impts. in warehousing or storing liquids and other goods.

3242. Benjamin Baugh, of Balsall-heath, Worcestershire, impd. machinery to be used in the manufacture of enamelled wares.

The above bear date December 29th.

3243. Enoch Shufflebotham, of Acocks-green, Worcestershire, impts. in girders for railways and for other purposes,—a communication.

3244. Elbert Perce, of New York, impts. in geographical globes and illustrative objects to be used therewith.

3245. Alexander Septimus Macrae and Abraham Bayley, of Liverpool, impts. in the burners of hydro-carbon fluid lamps.

3246. Arthur Cant Robb, of Brixton, impts. in machinery or apparatus for brushing hair.

3247. Edmond Couprant, of Paris, rotative motive power.

3250. Thomas Bouch, of Edinburgh, impts. in the construction of roofs for sheds, railway stations, and similar structures.

The above bear date December 30th.

3253. Joseph Ladley, of Leeds, impts. in carding engines.

3254. William Edward Newton, of Chancery-lane, impd. machinery for making horseshoes,—a communication.

3256. Thomas Richardson, of Newcastle-upon-Tyne, impts. in the manufacture of manures.

3258. Richard Quin, of Poland-street, impts. in the manufacture of cases for jewellery, for optical, and other instruments, and for miniatures and other articles.

3259. Thomas Du Boulay, of Sandgate, Kent, impts. in carriages propelled by manual power.

3260. Charles William Siemens, of Great George-street, impts. in the means and apparatus for obtaining and applying motive power,—partly a communication.

The above bear date December 31st.

1865.

1. William Muir, of Manchester, impts. in the construction of public houses and other houses of entertainment.

2. Thomas Antoney Macauley, of

Herbert-street, New North-road, impts. in sewing machines and apparatus belonging thereto.

5. John Frederick Parker and Joseph Tanner, of Birmingham, impts. in the manufacture of oxygen gas, and in treating and economizing the residual products of the said manufacture.

6. Joseph Smith, jun., of Bishop-wearmouth, and John Williamson, of Washington Colliery, impd. method of, and apparatus for, lubricating the axles or journals of coal or ironstone waggons or tubs, or of other carriages or rolleys used upon tramways or railways, for carrying mineral or other material.

7. John Spencer and Noah Broomhead, of Halifax, the application and use of certain materials to be employed in the manufacture of carpets and hearth rugs.

8. James Roger Crompton, of Elton, Lancashire, impts. in machinery for smoothing or finishing paper.

9. Robert Irvine, of Musselburgh, Mid Lothian, N.B., impts. in treating the pitch obtained in, or resulting from, the distillation of palm oil and other fats in candle making.

10. Frederick Gye, of Wandsworth-road, impts. in mounting photographic, printed, and other pictures, —a communication.

The above bear date January 2nd.

11. Martin Benson, of Hind-street, Manchester-square, impt. in ordinary lift and force pumps.

12. William George Helsby, of Liverpool, impts. in the manufacture of enamelled glass, to render it more useful in photographic art.

14. Henry Lloyd, of Liverpool, impts. in perambulators; a part or parts of which impts. may also be applied to other wheel carriages.

15. Léopold d'Aubréville, of Paris, impts. in manufacturing paper,—a communication.

16. Thomas John Ashton, of Cavendish-square, impd. portable pneumatic apparatus, applicable in surgery and medicine for all purposes as a douche for affusion, irrigation, injection, and for enemas.

17. Louis Goldberg, of Love-lane, City, impd. belt for ladies' wear.

The above bear date January 3rd.

19. Edward Kierby, of Rochdale, impts. in the manufacture of elastic packings for pistons, and in lubricating compositions therefor.

20. Walter Payton, of Westbourne-terrace North, Paddington, impts. in means or apparatus for measuring water or other liquids.

21. John Knowles, of Bolton, and James Banks, of Sharples, Lancashire, impts. in mules for spinning.

23. Wilson Ager, of New York, U.S.A., impts. in fan blowers.

25. John Franklin Jones, of Rochester, county of Monroe, U.S.A., impts. in machines for making paper board.

26. George Kent, of High Holborn, impts. in apparatus for cleansing and polishing knives.

28. William Henry Roy, of Upper Woburn-place, impd. means of checking the receipts of railway clerks.

The above bear date January 4th.

29. William Watson, of Johnstone, N.B., impts. in apparatus for propelling vessels.

33. John Malsbury Kirby, of Northampton, impts. in the means of, and apparatus for, generating steam and heat.

35. James Edwards Wilson, of Grassmere, Torquay, impts. in locomotive engines and in the springs of railway carriages.

37. James Chapman Amos, of the Grove, Southwark, and William Anderson, of Erith, impts. in the construction of tubular boilers and in the means for cleaning the tubes of such boilers.

39. Thomas Pickford, of Fenchurch-street, impts. in preparing and keeping aërated beverages.

The above bear date January 5th.

41. John Clowes Bayley, of Park-place-villas, Maida-hill, and Daniel Campbell, of Plumstead, impts. in lamps for burning the vapour of volatile fluids.

43. John Alfred Castree, of Manchester, impts. in looms for weaving.

45. John Craw and James Macaulay, of Paisley, impts. in weaving ornamental fabrics.
47. Walter Christopher Thurgar, of Norwich, impd. method of keeping the substance of eggs fresh and sweet.
49. George Haseltine, of Southampton-buildings, impts. in machinery for shaping and trimming the heels of boots and shoes,—a communication.
51. James Robertson, of Glasgow, N.B., impts. in furnaces, ashpits, and flues for the consumption of smoke and noxious products of combustion, and in the apparatus or means connected therewith.
53. George Reymond, of Geneva, impts. in the construction of escapements for watches and other time-keepers.

The above bear date January 6th.

61. Theophilus Horrex, of South-square, Gray's-inn, impts. in brushes for brushing the hair; which impts. are also applicable to brushes for other purposes.—*January 7th.*
63. Ashworth Barlow, of Crawshaw Booth, near Rawtenstall, Lancashire, impts. in jacks and slubbing frames.
67. Joseph Calkin, of Oakley-square, impts. in taps.
69. Richard Ashton Lightoller and George Henry Lightoller, of Chorley, Lancashire, impts. in flyers for preparing cotton, and other fibrous materials for spinning.

The above bear date January 9th.

73. Samuel Shaw Brown, of Runcorn, Cheshire, impts. in the manufacture of lint.
75. Edward Wilds Ladd and Ludwig Oertling, of Moorgate-street, impts. in hydrometers.
77. Humphrey Chamberlain, of Wakefield, impts. in machinery or apparatus for the manufacture of compressed bricks.

The above bear date January 10th.

New Patents Sealed.

1864.

1585. E. R. Turner and F. Turner.
1605. J. M. Johnson and J. Buckley.
1616. T. Thomson and J. Murray.
1624. Charles Frielinghaus.
1627. M. L. J. Lavater and E. W. Niblett.
1628. R. A. Brooman.
1632. Alonzo Kimball.
1634. William Brookes.
1637. Daniel Gallafent.
1638. F. L. H. Danchell.
1639. Thomas Day, sen., and Thomas Day, jun.
1644. E. T. St. Laurence McGwire.
1649. Alfred Thomas.
1653. N. Jarvie and W. Miller.
1658. W. Jackson, T. Glaholm, and S. S. Robson.
1660. A. S. Tomkins.
1664. Henry Messer.
1665. R. K. Aitchison.
1665. David Blake.
1668. William Lloyd.
1670. B. Whitehouse and C. Priestland.
1671. J. E. Wilson.
1672. J. E. Wilson.
1674. Edward Clifton.
1675. J. B. Howell.
1678. E. Ratcliffe and C. Ainsworth.
1679. A. B. Von Rathen.
1682. John Spencer.
1683. E. M. Marsden.
1684. H. E. Skinner.
1687. Henry Crichley.
1691. James Wilson.
1693. E. H. Carbutt and W. Cutts.
1695. Alfred Blake.
1696. E. J. Dixon.
1697. A. C. Bamlett.
1698. Godfrey Russell.
1701. Abraham Rogers.
1702. J. Middleton and J. Conlong.
1707. R. A. Brooman.
1712. John Webster.
1715. Thomas Mc Grah.
1718. A. V. Newton.
1721. W. E. Gedge.
1723. F. L. H. Danchell.
1724. Jeremiah Robinson.
1725. Z. B. Smith and J. Richards.
1726. B. and J. Underwood.
1727. Stephen Carey.
1729. Ludwig Schad.
1731. S. J. V. Day.
1732. John Forbes.
1733. J. Tomlinson and T. Brassington.
1735. Adolph Bösch.

1737. G. O. Way.
1739. Joseph Francis.
1744. V. Pean and A. F. Le Gros.
1746. John Lewis.
1750. James Gilmour.
1756. R. Smith and J. Booth.
1758. Joseph Bernays.
1759. A. A. Croll.
1764. F. W. Turner.
1765. W. C. Thurgar.
1766. R. A. Brooman.
1767. John Clark.
1768. J. G. Tongue.
1770. Jones Saunders.
1771. D. B. Grove and W. Carron.
1776. John Gill.
1778. James Chalmers.
1780. Israel Swindells.
1782. Thomas Johnson.
1784. Amelie A. Bonnet.
1789. Andrew Barclay.
1790. Squire Whitehurst.
1791. William Whitley.
1794. W. M. Cranston.
1795. Frederick Seebohm.
1797. P. G. B. Westmacott.
1798. F. C. Cosseratt.
1799. A. Espirat and E. Sause.
1800. Edmund Lee.
1802. Theodore Bourne.
1803. John Maynes.
1804. H. E. F. De Brion.
1805. James Syme.
1806. Oliver Phalp.
1807. G. P. Harding.
1808. C. Whittaker and J. Cocker.
1809. Joseph Laubereau.
1811. W. H. Wilks.
1812. John Coton.
1817. John Hart.
1819. W. E. Gedge.
1821. John Whitford.
1823. A. V. Newton.
1824. A. Topp and J. Holt.
1825. James Higgins.
1827. W. E. Gedge.
1829. Frederick Peskett.
1830. E. Snell and G. Allibon.
1833. D. Hall and A. L. Roosen.
1834. Graham Stevenson.
1840. P. A. Le Boulengé.
1841. Francis Gregory.
1846. J. C. White.
1848. J. C. Ramsden.
1849. J. Jeffreys.
1852. Edward Peyton.
1857. H. A. Bonneville.
1859. F. L. Lyne.
1861. Albert Wydler.
1862. L. R. Bodmer.
1864. William Irwin.
1865. James Slater.
1866. Michael Scott.
1873. William Anderson.
1874. Vincent Wanostrocht.
1875. J. P. Chambeyron.
1876. J. P. Chambeyron.
1881. James Newsome.
1891. P. E. Fontenay.
1897. J. F. Hearsey.
1904. F. E. B. Beaumont.
1908. Charles Eastwood.
1920. J. H. Johnson.
1921. Samuel Hawksworth.
1930. P. B. G. Westmacott.
1937. Bernard O'Connor.
1949. A. H. A. Pflughaupt.
1956. George Leyshon.
1963. Neil McHaffie.
1970. J. H. Johnson.
1979. Archibald Turner.
1985. John Grice.
1987. George Haseltine.
2022. John Hodgart.
2033. E. A. Pontifex.
2040. A. V. Newton.
2046. G. Coles, J. A. Jaques, and J. A. Fanshawe.
2092. Richard Pilkington.
2137. John Stenhouse.
2144. Ernesto Petito.
2167. William Langham.
2169. A. V. Newton.
2174. Frederick Weaver.
2319. J. H. Johnson.
2351. William Whittle.
2398. Thomas Bennett.
2406. J. T. Pendlebury.
2421. Henry Druce.
2462. Henry Nelson.
2463. F. W. Shields.
2477. H. Kemp and F. J. Kemp.
2486. C. H. Collette.
2507. G. Coles, J. A. Jaques, and J. A. Fanshawe.
2594. L. H. G. Ehrhardt.
2600. W. H. Hardfile.
2664. E. J. W. Parnacott.
2689. Bernard Scalé.
2714. E. L. S. Benzon.
2747. J. D. Young.
2759. W. E. Newton and E. C. Shepard.
2819. Charles Martin.
2841. F. E. Vickers.
2927. François Pfanhauser.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S

London Journal of Arts and Sciences.

No. CXXIII. (NEW SERIES), March 1st, 1865.

NOTES ON THE REPORT ON THE PATENT LAWS BY THE ROYAL COMMISSION.

The issue of the long-delayed report of the Royal Commission appointed, in the year 1862, "to inquire into the working of the law relating to letters patent for inventions," has been heralded by an announcement from the Throne that the interests of inventors are no longer to remain in abeyance. By this act of the Crown the Government are pledged to prompt action on the question of patent law reform; and it remains for those who can assist in reconciling some of the diverse views expressed on the subject to do their best in promoting a unanimity of opinion, and thereby facilitating the enactment of a good, practical law, which shall remove all grounds for agitation or further legislation in this direction.

The blue book which the Royal Commission presented to the Houses of Parliament at the opening of the session, as the result of their protracted and conscientious labours, although not of so bulky a character as might have been expected, is a fair exposition of the opinions of the country on patent law and its requirements.

The way the evidence has been collected is very commendable, and serves as a valuable hint for obtaining information on other matters involving varied mercantile and professional interests. The evidence, both oral and written, received by the Commission is arranged analytically under twelve heads; the divisions relating each to one of a series of questions drawn up and circulated by the Commission. In the analytical table we find a system adopted of grouping the evidence according to the source whence it is derived. This arrangement has the advantage of shewing at a glance what interests, so to speak, are represented, and what are the views of those interests. Thus we have the Patent Office and the Privy Council Office represented by three officials.

Next in order come three patent agents; then three barristers, selected for their knowledge of the patent law practice; and following these are seven engineers and manufacturers. These include all the witnesses examined by the Commission. But, in addition, the blue book contains the written opinions of a law lord, an equity judge, and a law officer of the Crown. Then we have the answers of the Chambers of Commerce, and of scientific institutions, and of gentlemen who come under no particular category, but who, from their familiarity with the working of patents, and of contentions arising out of patents, were invited to reply to the circulated questions.

In this manner the Commission have obtained the opinions of the country, and, sacrificing their individual predilections, they have settled —though not without much discussion, and the final disagreement of two of their number — a report which will, doubtless, form the basis for a bill which may shortly be expected to be brought before the legislature. This report—arrived at, as it has been, after the consideration of much controversial evidence—is not, as might be predicated, of a very precise or definite character; but, if adopted as a basis for legislation, it will, in our opinion, serve for the production of a very good law. It, however, embraces some objectionable points, which we trust will not receive the sanction of the legislature. The recommendations—which are seven in number—we will notice in order, and explain their working by anticipation; assuming that they are embodied in an Act which the Government are bound to see carried through Parliament this session.

The Commission advise the retention of the existing fees on patents and the present mode of paying them, with the understanding that the claims of the Patent Office are to be satisfied by the surplus funds before any contributions are made therefrom to the State. This implies that the erection of a suitable Patent Office, and the maintenance of a proper staff of officers, equal to the extended range of duties to be undertaken by the office, should not depend on the generosity of the House of Commons, but be defrayed out of the surplus funds.

Their second recommendation is, that all applications for patents shall be submitted to a preliminary investigation, to test their novelty; and that, in the event of the want of novelty of any alleged invention being established to the satisfaction of the law officers, the patent shall be refused—with option of appeal to the Lord Chancellor. We are not sure that the Commission have fully appreciated the organic change which this recommendation involves; but, if it is to be acted on, it is well that the Government should know something of the difficulties that will follow the undertaking of their herculean task. In the first place,

analytical indices have to be made of all the recorded inventions, showing not merely what is the subject matter claimed, but whatever appears in any specification for the first time as a subsidiary invention.* As the patents granted prior to the act of 1852 number 14,359 in Mr. Woodcroft's list, and the applications have since increased at the rate of three thousand per annum, we have at this moment some 50,000 recorded applications, many of which embrace half a dozen distinct inventions, to be submitted to analytical investigation to discover in what they consist. These have to be epitomised, so that, at a glance, an examiner may see that they do not contain that of which he is in search; and then to be skilfully grouped under various heads and sub-heads, according to their subject matter. The labour of such a work can only be appreciated by the few who have tried their hands at it; and when men are found competent to the work, it will be a very long time before the proper indices are ready for the use of the examiners, whose duty it will be to advise the law officers as to the novelty of every new application. But it may be said that the Patent Office is already, to a great extent, prepared on this head by reason of the printed abridgments of specifications, which have, from time to time, been issued. To this we would reply, that admitting, for the sake of argument, their value,† they as yet cover but a narrow field of invention, many of the most important subjects not having yet been touched; and in no single instance are the abstracts brought up to within three years of the present time. Moreover, such lengthy abridgments are altogether unsuited to the use of examiners, and serve rather to bewilder than assist their investigations. Assuming, however, this difficulty to be removed,—and in time, by a heavy expenditure, it may be,—there arises another difficulty, viz., Where are we to look for an efficient staff of examiners? Men suited to this work are simply not to be found; they must be created, and that by being set to the subordinate duties of index making. Indeed, they can never be wholly clear of this work, for as they will, by daily reference, be constantly putting the completeness of the indices to the test, so must they of necessity be constantly correcting omissions which every-day experience brings to light. The expense consequent on an examination as to novelty will necessarily

* The writer was strongly impressed with the importance of this fact some years ago, when, in searching to establish the originality of a patented railway buffer spring, prior to commencing an action for an infringement of the patent, a minute spring of similar construction was found in the drawing of an old specification for a gun lock, but not forming any part of the patented invention, and, therefore, not mentioned in the description.

† The true value to be set on these publications, which originated in the thoughtful suggestion of Mr. Woodcroft, but were unfortunately entrusted to most incompetent hands, will be seen by reference to a review in this *Journal*, of the first fourteen of the abridgments. See Vol. X., p. 319.

increase yearly somewhat in the ratio of the educational grants; and, if all scientific literature, both British and Foreign, is to be ransacked, and the inventions described therein indexed and brought to bear upon all applications for patents, we cannot pretend to estimate the number of index clerks and examiners that will be required to meet the current business of the office; nor would we attempt to foretell the time that will intervene between the date of application and the date of allowance of a patent, while the clerks and examiners are new to their work. The examination to establish the novelty is intended, we presume, to be made prior to granting the certificate of provisional protection, or otherwise it would be in addition to the examination now made by the law officers for a different object.

There is, however, another phase of this question, which it behoves inventors and their professional advisers carefully to consider before this recommendation of the Commission is adopted by the Government, and that is, what effect will the examination have on the construction of provisional specifications? It will be remembered that the English patent law is peculiar in one respect, viz., that a patentee is allowed six months to perfect his invention and prepare his complete specification for deposit. There can be no doubt that this is a very great benefit to inventors, and it is perhaps due as much to this cause as to any other that the specifications of English patents are in general more satisfactory documents than those of continental patents. But if an examination to test the novelty of an invention is to be instituted, it is clear that not only must the nature of the invention be disclosed by the provisional specification, but the limits of the invention also. Claims must therefore be appended, and how many inventors, when introducing their inventions to the notice of their legal advisers, are in a position to instruct them in respect of the claims? Is it not well if they can, besides making clear the nature of their invention, foresee also the extent of its application? The fact which we deduce from the introduction of the system of examination, recommended by the Commission, is that it will most certainly bring about the granting of patents upon complete specifications. Let inventors consider whether they are prepared for this, without obtaining the palliatives, offered by the American law, of securing priority of invention by means of a caveat, and the rectification of errors in the specification by a re-issue of the patent; or that contained in the French law, in the form of patents of addition.

The third recommendation relates to the trial of patent causes, and suggests the appointment of scientific assessors in lieu of a jury, to aid the judge in deciding between the parties to the suit. Indeed, so

unanimous was the evidence of witnesses examined by the Commission on this point, that they could not have arrived at any other conclusion. Nothing is said respecting the preliminary proceedings, but sufficient evidence is adduced to show the necessity for abolishing the existing practice of settling the particulars of breaches and notices of objections in the judge's chambers. The system which we have advocated in this journal, and elsewhere, is virtually accepted by several witnesses practically acquainted with patent litigation; and the Chambers of Commerce of Bristol and Glasgow considered the suggestion of sufficient importance to memorialise the Commission thereon (after they had sent in their answers to the list of printed questions), referring in terms to our notice of the sewing machine case tried by the Lord Chancellor, in March, 1864. Certain we are that, without the intervention of some official personage, who shall, before the commencement of a contemplated suit, make himself master of the question to be adjudicated, and, by withholding his certificate, stop proceedings in the absence of a *primâ facie* case of infringement, no amendment in the mere constitution of the court will suffice to give justice to the public; neither can justice be dealt between the parties to a suit, unless through the preparation of a special case agreed upon by the parties, each knows the case which he is required to meet. We shall hope to see this matter considered by the law officers, and embodied in the Bill which the Lord Chancellor has signified his intention of introducing to Parliament.

With respect to the question of compulsory licenses, the Commission consider that no case is made out for compelling patentees to part with a portion of their rights, on receipt of an adequate payment, to manufacturers or others who may be desirous of carrying out improvements which they may have made in a branch of manufacture inaugurated by, and therefore closed up by, an original patented invention. Yet, singularly enough, in order that the free action of the Government officials may not be interfered with, they propose that patents shall have no effect against the Crown, and that the remuneration a patentee shall receive by the official invasion of his rights shall be settled by no judicial authority, but by the Treasury. There is a degree of inconsistency in this finding which we are unable to reconcile, but we doubt not that eventually a claim so reasonable and just as compulsory licenses, will be conceded by the legislature.

The recommendation that patents should not be granted to importers of foreign inventions, standing by itself, is open to misinterpretation; but the evidence on this point, and the arguments based thereon, go to show that mere importers — that is, importers not representing the original inventor as assignee or otherwise—have no claim to the reward

of a patent. With this view, we warmly agree, remembering instances where the original inventors have—by reason of the laxity of the law in this particular—been debarred by knaves from using their own inventions in this country.

The last recommendation to which we have to call attention is, that patents should not be extended beyond the original period of fourteen years. This opinion is arrived at solely from a consideration of the evidence of Mr. Rees, of the Privy Council Office, who has officially become acquainted with the not very creditable manœuvres occasionally brought to light in the Privy Council, but who is otherwise no authority on the policy or working of extensions. With the conclusion arrived at by the Commission we cannot concur, nor, we think, will patentees generally. The power of prolongation is intended for exceptional cases, and applied only in such cases. It has preserved many a patentee from want, and as it enables an inventor sometimes to regain an interest in a valuable patent which he has been compelled to part with for a trifle, through poverty, it is one of the last privileges which we think should be withdrawn. We are glad, however, to find that Mr. Hindmarch and Mr. Fairbairn have entered their protest against this recommendation of their fellow Commissioners.

COAL: ITS BEARING ON MODERN CIVILIZATION.

Of all the characteristics which have been adduced as serving to distinguish man from every other animal, none is more clearly defined and unequivocally established than the special use which human beings make of fire; and so intimately does the employment of this element appear to be interwoven with the superiority of our race, that a simple collection of the facts which first led mankind to the adoption of fuel as a source of artificial heat, would form, in effect, a key to the whole history of human progress and civilization. It may have originated in instinct, or it may have been the result of observation and reason; but from whatever it arose in the first instance, the use of fire not only established a wide distinction betwixt man and the inferior animals, but, by the relative degree of its application, constitutes no bad guide to the comparative civilization existing amongst men themselves. Thus the social position of a nation might be more correctly deduced from the extent of its application of artificial heat, than, perhaps, from any other single datum whatever. The investigation of the subject of fuel is not, therefore, wanting in importance.

When and by whom this mighty agent was rendered originally subservient to the wants of mankind, will for ever remain a mystery, but from what we know of savage nations at the present day, it is almost certain that a period once prevailed in which the use of fire was unknown to humanity. The ancient mythologists tell us "it was stolen from Heaven by Prometheus," which may allude to the first employment of the sun's rays through the aid of a reflector, or it may have reference to the action of lightning; but in any case, the circumstance clearly points to a traditionary epoch at which fire was unused. Remembering, however, that the employment of fuel must long have preceded every other usage of civilised life, it is easy to understand the cause of that entire silence which prevails respecting its introduction, because the practice of recording discoveries of this kind could only have ensued many ages after the use of fuel had become so common as neither to attract attention nor to require comment. Shut off, therefore, from every source of authentic information upon this subject, we next turn to an inquiry of the means originally used to obtain heat, and, fortunately, on this head we meet with no great difficulty. All accounts agree in declaring wood to have been the fuel of the ancients, and, in a practical sense, to have continued so up to within a comparatively recent date. True, we find the word "coal" occurring in the Scriptures, and in some old writings, but this is well known to mean "charred wood," or charcoal, and to have no reference to the mineral which now passes under that name. Admitting, therefore, the incontestible fact that, in one or other shape, wood really constituted the fuel of the ancients, let us pause for a moment to consider the effect of this peculiar circumstance, which, though seemingly of trifling import, no doubt caused the downfall of the mightiest empires of the old world. It has been said, "knowledge is power," or, in other words, that "the application of knowledge gives power," and, in this sense, heat is the most powerful agent which human knowledge can apply. To be useful or powerful it is, however, necessary that the source of heat should increase as the demand increases; otherwise the power must be controlled by the source, and either remain stationary or recede. With wood as a fuel, the latter conditions are inevitable, for the extension of mankind must lead to a destruction of trees in two ways—firstly, as requiring more fuel, and, secondly, as demanding an increased supply of vegetable food, and, consequently, a larger area of cultivated land: an enlargement of human power must therefore, in this way, produce a diminution of the source of heat, and thus these forces are brought into diametrical opposition. The carbonaceous produce of the land, if burnt in the lungs of the animal, cannot, of course, be at the same time

burnt in the furnace of the steam engine; and hence an increase of the population in former times came to present the fatal anomaly of a decrease in the power of production, as regards manufactured wealth. To maintain so unnatural a condition of social existence required the exercise of means equally unnatural, and therefore that kind of wholesale plundering, denominated "war" by the ancients, became an indispensable trade or business, and as such was carried on in succession by various nations—Assyrians, Jews, Egyptians, Greeks, and Romans. By this brutal system the industrial productions of a large part of the habitable globe were periodically torn from their owners, and gathered together in some special locality already exhausted of its own resources, and here for a time the products of rapine served to support the contest of art with nature, and enabled the over-crowded cities of Greece, or Rome, or other dominant power, to purchase at a fabulous cost those comforts and conveniences which the want of manufacturing industry denied to their inhabitants upon any other conditions. Thus a large city became in fact a kind of social "maelstrom," engulphing all, and returning only wreck, vice, and crime; for how, except by injury to the best principles of human nature, can any large community exist without the regular forms of industrial production? The history of Rome, even in the most flourishing period of its existence, reads more like the records of a gang of banditti, than the proceedings of a great and honorable nation. That such a pest should have fallen at last by violence is a necessary consequence of the reaction which justice ever demands; but who can question that had Rome based her supremacy amongst men upon industrial superiority, she might yet have stood proudly at the head of human progression, and instead of miserably striving to hoodwink a jeering world by the exploded idolatry of a past age, have assisted in raising that veil which already scarcely hides the practical wonders of the coming century. But, as has been before remarked, the absence of fuel rendered any well-sustained effort of the above kind impossible, and therefore the genius of the Roman people developed itself in another direction. Steam for the Romans was like aerial navigation for the English—a phantom, destitute of substance. Where was the requisite fuel to come from? And let us not forget, that without an almost endless supply of highly-calorific coal, the steam engine would be quite useless even to Great Britain. If, for argument's sake, we conceive that wood might answer the purpose, whence could the enormous quantity required be obtained?

In those situations where, from necessity, wood was used formerly with Mr. Watt's engines, he was in the habit of ordering three times as much of it as of coal, to produce the same effect; and since, in

stowage, wood occupies for an equal weight double the space, we see that six times the stowage now required in steam vessels for fuel would be necessary. Had Cæsar, therefore, possessed a steamer, it would have been for him little better than a philosophical toy. It might, perhaps, have been able to carry its own machinery and fuel from the Tiber to the Thames, but for merchandise, troops, or munitions of war, there could have been no vacant space whatever; and similar difficulties would have beset the application of locomotive and even stationary engines. It is not many centuries since iron furnaces existed in most of the densely-wooded parts of this island, and now where are they? The production of a few tons of iron soon laid bare many acres of forest, and the manufacturing demands of a week consumed the natural growth of a century; until ultimately the supply of fuel being exhausted, the furnace disappeared. Where iron is still made by means of the catalan forge, it is usual to allow a consumption of seven tons of charcoal for every ton of iron produced, which is equal to the destruction of at least 28 tons of timber; and since the yearly production of pig iron in Great Britain amounts to 2¼ millions of tons, it would require no less than 62 millions of tons of wood to supply the annual demand of this country in respect to this single manufacture—a quantity which probably exceeds the annual growth of all Europe. It would therefore be quite impossible to meet the present requirements for fuel in case wood was needed to supplant coal; consequently, in contrasting our position with that of the ancients, we must not forget that even now, if limited to their circumstances in this one respect, we should not, perhaps, greatly exceed them in most others. It is the power of fuel which gives to the modern his wonderful strength, and enables him to turn the most energetic forces of nature to his use,—rendering those things which were formerly impediments to human progress the means of subduing still greater difficulties. Yet this very power may be said to have offered its services to Rome, and to have been refused; for it is a curious historical fact that the kind of coal which, from its excellent quality, has given a name to all the best kinds of household coal, itself derived that name from a Roman work executed more than seventeen centuries ago. Beneath the very spot where the great wall terminated, which was built by Hadrian to repel the incursions of the Picts and Caledoniæ into England, the variety of coal called Wallsend was first dug, and received its appellation from a neighbouring village, which time out of mind had borne that name, and marked the termination of the wall. How little could Hadrian or Severus, or those whom they employed, foresee the importance of that locality, from whence coals are now actually sent to light the Vatican

itself! And how little did they appreciate the worth of what lay beneath their feet? The poverty of Britain was then proverbial; Cæsar could find neither gold nor silver in it; and now the extraction of coal alone adds annually more than 18 millions sterling directly to our wealth. Let us hope that the British Government at present is less blind to the real worth of our colonial possessions than were the Romans 1800 years since in regard to the universal treasures of this island.

The period at which coals were first employed as fuel seems involved in considerable obscurity, though it is probably not very remote. According to some accounts, the Romans used coal during the construction of the Roman wall; but as the island of Great Britain was then almost one continuous forest, and the inhabitants far from numerous, it is not likely that any deficiency of wood could ensue and give rise to the use of mineral fuel, even if we could suppose that the means of extracting and consuming it were well known. There seems, on the contrary, no reason to presume that coal found any great favour amongst the bulk of the people until the scarcity of wood rendered a change indispensable. On the sea shores and in the banks of the rivers in the North of England, the coal strata make their appearance in many places, and coal may easily be gathered by the hand; it is therefore probable that, driven by necessity, the poorest and most barbarous of the inhabitants of these districts first made trial of its calorific qualities. Beginning under such auspices, its more general introduction would be slow, and not devoid of prejudice, as appears to have been the case; whereas, had it received the sanction of Roman patronage, a very opposite effect must have followed. A manuscript yet exists, dated prior to the year 1195, in which, amongst other concessions by a feudal lord of that day to several of his vassals in the neighbourhood of Bishopwearmouth, there is a grant of twelve acres of land to a blacksmith or armourer, with the privilege of extracting coal for the use of his forge. But the first evidence of this description, which is of an incontestible nature, as establishing the value of such a concession, is a charter by Henry III., granted to the inhabitants of Newcastle, and bearing date December 1st, 1239: this charter, in reply to the demand of the burgesses of that town, granted them the power or royalty of extracting coal and stone in their neighbourhood.

The name given to coal at this period seems, however, to show that it was even then an article of transport by sea, for it is called "carbo maris," or sea coal, in several documents of that age, and a historical publication, of the year 1245, not only mentions coal under this title, but speaks of the pits from whence it was extracted, and makes

allusion to the wages of the pitmen. The extraction and employment of coal seems, however, to have made but little progress until about the year 1280, after which time it steadily and rapidly made way, so much so as to have absorbed in its history that of the town of Newcastle-upon-Tyne itself, until the two have become almost identical. The first shipments to London most probably occurred towards the beginning of the fourteenth century, for we find that in the year 1357 this combustible had begun to attract attention at that port, as an article of commerce. The exportation of coal from Newcastle seems, indeed, to have progressed favourably, and, as might be expected, became at the earliest opportunity a subject for fiscal rapacity. Thus, on the 2nd of May, 1421, an Act of Parliament was passed, authorising the collection of a tax of twopence per chaldron upon all coals leaving the port of Tyne in ships or keels, and the Act farther states, that whereas many of the keels "carry more than they ought to do," this is proposed to be remedied by royal commissioners, who are to "measure and mark the keels"—a regulation still in force. Though seemingly small, this tax was really heavy at the date of its infliction, and excited much discontent in the north. Nor is this surprising, when we consider that the price of the coal at Newcastle was then not perhaps more than sixpence per chaldron, for even so late as the reign of Henry VIII., coals were sold at twelve pence per chaldron at Newcastle, and no more than four shillings at London. The export or rather shipping trade of Newcastle rapidly passed into the hands of a particular class, who, having arranged themselves into a kind of company, under the designation "Hostmen" seem to have maintained the whole of the keels on the river, and to have lodged or acted as purveyors to the captains of the vessels in want of coals. About the year 1599 these hostmen were incorporated, and are now represented at Newcastle by the class of factors called "fitters." In spite of obstacles, which will be hereafter alluded to, and the most iniquitous system of taxation, the trade in coal advanced with the most amazing rapidity; and not only London and the eastern coast of England were well supplied with this invaluable fuel, but even Holland, France, and Spain received supplies so early as the 15th century; and in the year 1622 the quantity thus sold appears to have reached the respectable figure of 14,420 tons. With her usual cupidity, Queen Elizabeth not only imposed additional taxes upon this inestimable form of industry but subjected it to the most shameful monopolies. In consequence of this the trade gradually languished, and the price of coal increased, until, during the civil wars of Charles the First, the price of coals, from one cause or other, had risen in the port of London to £4 per London chaldron; the king,

meantime, exporting coals to Holland in exchange for gunpowder and bullets wherewith to shoot his rebellious subjects. The great fire of London, in 1666, gave occasion for fresh imposts upon the coal trade, and these were accordingly laid on to assist in building the present St. Paul's Cathedral and fifty other churches, which had been destroyed by that conflagration. The success of this unjust tax seems to have roused the profligacy of Charles the Second into a belief that any amount of spoliation might be employed with impunity, and, consistently with such an opinion, the notorious Richmond shilling was imposed, in the shape of a royal grant of "one shilling per chaldron of coals shipped, to be paid to Charles Lennox and his heirs for ever." Persons unacquainted with the glaring monstrosities which disfigure the fair face of British legislation would naturally conclude that the said Charles Lennox had either greatly benefitted the coal interest or, at all events, had achieved some very essential service for the country at large, which rendered him a proper recipient of so valuable a gift: they would no doubt, therefore, regret their obliviousness of English history, and ask what the particular service was which Lennox had performed? The answer could not fail to astonish them:—"He was the illegitimate son of the virtuous individual who issued the grant." Yet this detested tax continued to increase, and was enjoyed by the descendants of this man, until, at length, Parliament interfered, and the right was bought up for the handsome sum of £400,000 in the year 1799; after which the continued collection of this shilling not only paid the interest of the purchase money at £5 per cent., but, so early as the year 1830, had paid off the purchase money in full, and accumulated a surplus of £341,900! Impediments of this kind were not, however, the only ones thrown in the way of the coal trade: ignorance, prejudice, self-interest, and a ministerial desire to make political capital have each had their personal representatives in opposition to this truly national industry. From the semi-barbarous ages of Henry III. and Edward I. down to the present moment, there have been individuals ever ready to make the most they could from an outcry against coal. Influenced by the fears of the wood and charcoal sellers, Edward I., in 1306, prohibited the burning of coal in London, because it was calculated, by its "fumes and soot, to poison the inhabitants;" and yet an entry occurs, in the accounts of the royal kitchen at that very time, which proves the total insincerity of the pretext, for coals are there mentioned, with wood and charcoal, as being used in the culinary department; and most probably they were used in other parts of the royal household. Their obvious economy seems to have forced their introduction in spite of everything, or otherwise the hypocritical pre-

tences advanced against their use must have prevailed—pretences which, with shame be it said, are not wanting in the present day.

Resuming our brief history of the progressive employment of coal, it becomes necessary to say little more than that, as improved and enlightened political views gradually removed the unwise obstructions of former years, the trade in this article expanded. The ameliorations introduced within the last quarter of a century have given an impulse which is likely to continue and to lead to still greater improvements, though, as heretofore, there are not wanting certain intermeddling, popularity-hunting personages, who willingly lend themselves to the antiquated cry of "smoke, soot, fume, poison," &c. In fact, the system of fishing for votes in the House of Commons with *a pauper as a bait* has become a regular ministerial business, and, therefore, the country is incessantly appealed to to create a kind of El Dorado, where poverty shall be unknown. "Baths and washhouses for the poor, education for the poor, improved dwellings for the poor, sanitary regulations for the poor, whitewashing for the poor, pure water for the poor, pure air for the poor"—*everything* "for the poor," except the inculcation of those sentiments of industry, honest pride, and self-dependence, which, if they do not annihilate poverty, at least destroy its bitterness.

It would be perhaps impossible to ascertain the quantity of coal actually raised in Great Britain, as much of it is consumed, so to say, on the spot, in making iron, coke, &c.; but, from the imperfect returns we possess, it appears that upwards of 32,000,000 of tons are annually sold and delivered into commerce. To convey some idea of the power thus given to the industry of the nation, we will convert this quantity of coal into its equivalent horse-power upon the least favorable condition—the standard assigned for the commonest form of the steam engine—and which is, that a consumption of 8 lbs. of coals per hour is equal to 1-horse power. Assuming, then, that a horse can work 12 hours per day all the year round, we have a consumption of 96 lbs. of coal per day, or less than 15 tons per year, for the labour of a horse; consequently, the coal annually sold from the collieries of this island is more than equal to the efforts of 2,100,000 horses!

Hitherto our narrative has had reference wholly to the coal mines of Newcastle-on-Tyne; but—although these bore the brunt of the difficulties connected with the introduction of this kind of fuel, and were for a long time the only commercial exponents of the trade—they now constitute but a modicum of this immense industry. So late as the year 1699 the export trade of the Tyne formed two-thirds of the whole business; but since then, or rather since the time of the Commonwealth, the Wear has become a most formidable rival, and now almost

equals the Tyne in exports. The Tees also, within the last forty years, has begun to assume a most prominent position; and the discovery of the process of puddling iron has, during the last half century, led to such a development of the mineral resources of Staffordshire and South Wales as would be incredible were the facts not established beyond the power of contradiction. Our railway system has also opened out the coal districts of Yorkshire, South Durham, Lancashire, Derbyshire, and Somersetshire, whilst the remarkable invention called the "hot blast" has brought nearly half the area of Scotland into the coal market. It may, therefore, be taken for granted that an interest so large, so widely diffused, and so very important to the community will not again suffer from the mischievous restrictions of a former age, whether sought to be inflicted by intermeddling ignorance or the impulses of a less commendable motive.

(*To be continued.*)

Recent Patents.

To HENRI ADRIEN BONNEVILLE, *of Porchester-terrace, for a new semi-fluid or solid product obtained by concentrating the saponaceous parts of the quillai tree,—being a communication.*—[Dated 21st April, 1864.]

THIS invention consists in obtaining from the bark of the quillai tree (Panama wood), a semi-fluid or solid product, which may be applied to scouring wool and other uses, instead of the alkalies now employed for this purpose.

The process, which is susceptible of great variations, is as follows:—The saponaceous parts of the bark, having been extracted by steeping and pounding or boiling and pressing, the water is evaporated in shallow vessels in the open air or by artificial heat, until of the consistence of syrup; and in order to obtain a solid product the residue is dried on marble slabs, thus forming crusts or sheets, which dissolve readily.

Up to the present day the properties of the soapy substance contained by this bark have not been industrially used, particularly for the scouring of wools, spun, woven, or in grease, although the simple solution obtained by steeping or boiling has been employed for replacing the alkaline substances and soap, with alkaline bases, habitually employed for the purpose, the first of which are always more or less hurtful, and the second only suitable for use in certain preparations. This soapy substance, a sort of balsam contained in the fibres of the bark, reveals to the smell an acid peculiar to the vegetable. It is perfectly soluble in water, whether hot or cold,

and in various proportions; it is unalterable by the action of the air; the various alkalies dissolve without decomposing it; and even the mineral acids are without sensible action on it. Alone, the fatty bodies paralyse its action, thus causing it to enter the category of substances, having the property of reacting on fatty bodies with or without causticity.

From the semi-fluid state to the solid state all degrees of solution required, according to the use proposed, may be obtained. Whatever its degree of concentration, it is innocuous to the most delicate colours. The process used for extracting this substance is the same as those usually employed for obtaining extracts of the kind, preferably by maceration and expression, either by pressing or rolling between cylinders. It is concentrated by heat or natural evaporation in the open air, but in the latter case in large shallow vessels.

To obtain the solid product, the semi-fluid is spread in thin coatings on marble slabs, when it is transformed to a hard substance, with resinous fissures, possessing all the same properties, but to a more intense degree.

The patentee claims, "concentrating to the state of syrup or paste, and desiccating to a solid state, the saponaceous parts of the bark of the quillai tree, whatever processes or modes of extraction are used for obtaining this concentration or desiccation."

To Henri Adrien Bonneville, *of Porchester-terrace, for improvements in making artificial leather,—being a communication.*—[Dated 21st April, 1864.]

This invention consists in making imitation leather from leather cuttings, shavings, parings, or leather fragments of any kind, by the following means:—The cuttings or other fragments are first reduced to powder, and the powder is then mixed with an equal volume of india-rubber dissolved in the ordinary way. A paste is thus formed, which is spread on metallic cloth, in order to form sheets of the required size and thickness. When the sheets are nearly dry at the surface, they are passed between cylinders, in order to unite well the mixture of flour and india-rubber. The desiccation is terminated either in the open air or by artificial heat, at a temperature of from 15° to 20° Cent. An article is thus obtained which may be used for the same purposes as real leather. Designs in relievo, incrustations, and other ornamentations of which the above product is susceptible may be applied by plates or rollers at a suitable stage of the process. The processes are, in short, the same as those for making paper or sheets of india-rubber, whether by mould or machine. The sheets or other pieces of composition obtained as above may, if required, be vulcanized in a bath composed of sulphuret of carbon and chloride of sulphur, in the proportion of 100 parts of the first to 1 of the second. In the mixture of leather flour and india-rubber, a suitable quantity of gums or resins may be comprised, making a sort of marine glue, taking as solvent the essential oil of tar. Gutta-percha, or the india-rubber

known in France as "gabon," or any suitable substance, may be used as a substitute for india-rubber.

The patentee claims, "making artificial leather from waste cuttings, shavings, or other fragments of leather, by the process above described, or other analogous means."

To EDWARD SNELL, *of Saltash, in the county of Cornwall, and* GEORGE ALLIBON, *of Greenwich, for improvements in the construction of anchors.*—[Dated 22nd July, 1864.]

THIS invention has for its object to give greater holding power, and also to dispense with the ordinary cross stock or sector of anchors, so that the anchor, when not in use, may be stowed away more conveniently than anchors of the ordinary kind. By the peculiar mode of constructing this anchor, the palms will be made to catch against and enter the ground with greater certainty than heretofore, and will hold with great tenacity.

In Plate VI., fig. 1 represents one of the double-grip anchors as it would lie on the ground before the palms enter the ground. *a*, *a*, is the shank; *b*, *b*, arms; *c*, *c*, horns, which catch against the ground and turn the palms *d*, *d*, into the ground. Fig. 2 represents the anchor in side elevation, and showing the palms *d*, as having turned down and entered the ground until the end or shoulder of the slotted joint *b**, is brought up by the stop *e*, at the end of the shank; *f*, is a small shackle to which the buoy rope is attached.

It will be seen that, whichever way the anchor falls on to the ground, the points of two of the horns *c*, *c*, must rest thereon; and upon any strain being put upon the shank *a*, (having a tendency to draw the anchor along the bottom) the horns will catch into the ground, and turn the palms or points of the arms downwards, as indicated by the dotted lines, until the arms are brought into the position shown in fig. 2; when the side or shoulder of the slotted eye or joint *b**, will be brought against the shoulder or stop *e*, of the shank, and the arms will be prevented from turning down any farther. It will be seen that, by this arrangement of parts, the anchor is not liable to foul, that a ship is not liable to injure her bottom from grounding on her anchor, and that no sector or cross stock will be necessary; consequently, the anchor will require much less room for stowage than an anchor of the ordinary construction, and great facility is given for withdrawing the anchor from foul ground, sunken wreck, ships' moorings, or other obstructions, as such withdrawal of the anchor may be effected by under running the cable—there being no stock to prevent the rope from reaching the arms—or by hauling in the buoy rope, and thus drawing out the anchor backwards.

The patentees claim, "the mode, herein set forth, of constructing anchors, whereby the cross stock or sector is dispensed with, and the anchor is caused to lie on the ground in the right position to compel the palms or ends of the arms to enter or penetrate the ground and take hold at once, as above described."

To Robert Thatcher, *of Brook Mills, Oldham, Lancashire, for improvements in lubricating machinery, for preparing, spinning, and doubling cotton and other fibrous substances.*—[Dated 8th April 1864.]

This invention consists, first, in lubricating slubbing, intermediate, and roving bobbin wheels and spindles, by means of a sponge or other absorbent material, which is placed in a groove formed on the outside of the bolster that supports the spindle, and on that part of it on to which the bobbin wheel fits. This sponge or other absorbent material will absorb the oil, and give it to the bobbin wheel and spindle, as required.

Secondly, in lubricating throstle and doubler spindles by means of a piece of sponge or other absorbent material, applied as hereinafter described. Holes are formed in the bolster rails, which are packed with sponge or other absorbent material, which will absorb the oil, and give it to the spindle as required, through a hole which connects the one in which the absorbent material is packed with the spindle. Or, instead of as above, a groove is formed on the outside of the bolster, and in this groove is placed the sponge or absorbent material, which absorbs the oil, and gives it as required, through a hole in the bolster to the spindle. Or, instead of as above, the bolster is made smaller in diameter than the hole in the rail into which it fits, and the absorbent material is wrapt round the bolster, when it absorbs the oil, and gives it to the spindle through a hole in the bolster. In this case the bolster is fastened in the rail by a nut in the under side, or the rail is made with holes smaller at the bottom than at the top, when the bolster is screwed into the smaller part, or fastened with a set screw. Or, instead of as above, the bolster is made in two parts. The outer one fits into the rail, and the inner one, which supports the spindle, screws or fits into the outer one: on the outside of the inner one is formed a groove, and in this groove is placed the absorbent material, which absorbs the oil, and gives it to the spindle as required, through a hole in the bolster. Or, when cup bolsters are used, the absorbent material is placed inside the cup and under the washer, but outside the tube that supports the spindle. This absorbent material will absorb the oil, and give it to the spindle as required, through a hole in the bolster.

The first-mentioned application of the invention is illustrated by the figure in Plate VI., where *a*, is the spindle; *b*, the bolster; *c*, the rail that carries the bolster; and *d*, the bobbin wheel. A groove is turned on the upper part of the bolster, and filled with sponge *e*, and a cap *f*, is fastened over it, to keep the sponge in its place; the bobbin wheel revolves on the outside of this cap. The oil is poured in at the top, between the bolster and cap, when it is absorbed by the sponge, which gives it through a hole e^1, to the bobbin wheel, or a hole e^2, to the spindle, as required.

The patentee claims, lubricating slubbing, intermediate, and roving bobbin wheels and spindles, by means of a sponge or other absorbent material, applied as shown and described in reference to the figure. He also shows other applications of his sponge lubricator.

To Joseph Cedric Rivett, *of Farnworth, near Bolton, Lancashire, for improvements in lubricators.*—[Dated 22nd April, 1864.]

The figure in Plate V., is a side view, partly in section, of a lubricator constructed according to this invention. *a, a,* is a cylindrical vessel, fitted with a piston *b*. Through the bottom of the cylinder is an orifice, fitted with a valve *c,* opening outwards, but kept up to its seat by a spiral spring *d,* pressing on its under side; this spring is coiled around the stem of the valve, which is of a triangular or other convenient form. The spring is contained in a chamber *e,* formed in a separate piece, and screwed into the bottom of the vessel *a*; this piece also is arranged to adapt itself by a screw to the machine to be lubricated at the part where the grease is required to be applied. To the upper part of the cylinder *a,* is fixed the frame or bridge *f,* at the top of which is a hole truly bored, into which the nut *g,* is fitted; it has, as is shown, a shoulder at its lower end, and at its upper end a worm wheel *h,* is fixed, and these between them retain the nut in its place in the frame or bridge. The worm wheel *h,* gears with a worm *i,* the axle i^1, of which is carried by a forked standard f^1, forming part of the frame *f*. *k,* is a ratchet wheel fixed on the axle i^1; and *l,* is a lever mounted on the same axle loosely, so as to be able to turn thereon. The outer end of this is intended to be connected with a rod, which links it to any convenient moving part of the machine to be lubricated, so that the lever receives an oscillating movement, the length of which can be adjusted, to some extent, by traversing the connecting rod along the slot at the end of the lever. *m,* is a pawl or driver, centred on a pin on the lever, and taking into the teeth of the ratchet wheel *k*; and thus, at each oscillation of the lever *l,* the worm *i,* is partly rotated, and the nut *g,* in this manner receives a slow motion. *n,* is a piston rod, with a screw formed upon it; the screw passes through the nut *g,* and its foot is reduced in diameter and pivots in a bridge piece b^1, on the piston, and has pin-jointed to it the ratchet disc *o,* which drops into gear with a similar ratchet disc fixed on the piston, or rises out of gear with it when the screw is turned in the direction in which the teeth incline upwards. The piston *b,* consists of two discs drawn towards each other by a screw and nut, and with hemp or other packing between them. This piston fits the cylinder or vessel sufficiently tight to prevent it rotating, so that the nut, in revolving, drives the screw and piston downwards; the ratchet discs clutching the screw to the piston, and preventing it turning. The piston, in descending, presses out the grease through the valve *c,* and so the lubrication goes on until the vessel *a,* requires to be refilled. For this purpose, the attendant, by turning back the screw by means of the hand wheel *p,* at the top of it, raises the piston out of the vessel *a,* the ratchet discs then allowing the screw to turn without the piston; the vessel *a,* is then refilled, and the screw is turned by the hand wheel, so as to lower the piston again into the vessel, the frame or bridge *f,* guiding it into its place; and as soon as the piston enters the vessel *a,* the ratchet discs again clutch together, and the self-acting delivery of the grease recommences.

To JOHN GUSTAVUS ROLLINS, *of Greenwich, for improvements in cotton gins,—being a communication.*—[Dated 21st April, 1864.]

THIS invention applies to the class of gins known as saw gins: in these gins the seed cotton is put into a hopper, one side of which is made with a grating, consisting of bars placed parallel the one to the other, and a short distance apart. Between these bars a number of circular saws enter a short distance; and the saws, in revolving, catch the cotton and draw it between the bars; but the seeds are stopped back, the bars being too close together to allow them to pass. The cotton is taken off the teeth of the saws and discharged from the machine by a revolving brush.

Now, according to this invention, the saws, after they have taken the cotton, are caused to carry it through a second grating, placed on the opposite side of the axis of the saws to that on which the hopper is situated; and beyond this second grating the cotton is also carried through a stationary brush, before it is taken from the saws by the rotatory brush, as heretofore. By these additions, the working of saw gins is found to be greatly improved.

The figure in Plate V., is a longitudinal section of a cotton gin constructed according to this invention. *a, a*, is the frame of the machine; it carries in bearings the axle *b*, on which the saws *c*, are mounted. *d*, is a hopper, hinged to the frame at d^1: the front of this hopper is grated as is usual, the metal bars d^2, being attached separately by screws to the hopper, as is shown. The front board d^3, of the hopper is adjustable, so that its position can be varied according to the amount of working the cotton seed requires to free it of fibre before it is allowed to escape. There is, for this purpose, on each of the side cheeks of the hopper, a moveable piece d^4, which can be clamped, in any desired position, by a bolt passing through a slotted hole in the side cheek, and receiving a nut beyond. Each of these moveable pieces has a hole formed in it, into which a bolt on the front board d^3, is shot: at the top of the board d^3, are pins, which drop into one or other of three notches in the side cheeks, as is shown. *e*, are screws against which the lower part of the hopper *d*, rests: by screwing them in or out, the distance the saws *c*, project between the bars d^2, can be adjusted. The saws, as they take the fibre from the seed in the hopper, carry it between the bars d^2, and then through the second grating *f*, the bars of which are formed of strips of wood, nailed to the cross bar a^1, of the frame; these strips are of such a width as just to enter freely the spaces between the saws, and they serve effectually to keep back and separate any seed which may be drawn between the bars d^2. *g*, is a brush immediately behind the grating *f*; it is fixed to the cross piece a^1, and has on it a number of tufts of bristles, arranged at distances apart, equal to the spaces between the saws, so that there is a tuft for each saw; and the brush is adjusted in position, so that the teeth of each saw may pass through its tuft: this brush tends to keep back burrs and knots, and to straighten the fibre. *h, h*, are guards at each end of the grating *f*, to prevent the passage onwards of any fibre or material which might otherwise escape past the grating *f*, at its ends: *i*, is a rotating brush, such as is usually employed to strip the cotton from the saws, and throw

it out of the machine. The gin may be driven either by a crank handle or by a strap passing round a pulley, both of which are mounted on the axle *b*, of the saws.

To George Hodgson, *of Bradford, Yorkshire, and* Alexander Hennah Martin, *of Buttershaw Mills, near Bradford, for improvements in means or apparatus employed when giving motion to rotary shuttle boxes of looms.*—[Dated 6th May, 1864.]

The object of the improvements is to give increased steadiness to rotary shuttle boxes after each change from one shuttle chamber to another, so as to facilitate the obtaining greater speed in the working of looms having such shuttle boxes.

In Plate VI., fig. 1 shows an end view of parts of a loom, arranged according to this invention. *a*, *a*, indicates part of the framing, supported by the batten, for carrying a series of rotary shuttle chambers or boxes, which are affixed to a tube *c*, and revolve on the fixed axis c^1. *d*, *d*, are hooked rods, the hooked ends d^1, of which, in order to give motion to the boxes in the order desired, act upon the pins *e*, projecting from the plate e^1, which is affixed to the tube *c*, all which is similar to what is ordinarily practised. *f*, *f*, are short levers, each of which is supported, and turns upon a pin *f*, projecting from part of the framing *a*, whilst the lower end thereof is acted upon by a spring f^2, with a tendency to draw its upper end towards the rod *d*. Each of these rods *d*, is formed to admit of the upper ends of a lever *f*, being drawn by the spring f^2, out of the way of the studs *e*, in the plate e^1, in order that one series of shuttle chambers or boxes may be caused to revolve on the axis c^1, by hand; or until, by the action of the hooked end d^1, of either of those rods upon one of the studs *e*, a partial rotation has been given to the series of boxes, to effect a change from one box or shuttle chamber to the next; and then the part d^2, of the rod *d*, which has thus acted, operates upon the end of a lever *f*, to move it under a pin *e*, when such lever acts, as indicated, to prevent the further rotation of the box in that direction, until that rod *d*, is again raised.

Fig. 2 shows a modification of the improvements. In this case the upper part d^3, of each rod *d*, is inclined in such manner that when one of the hooked ends d^1, has acted upon a stud *e*, to cause a partial rotation of the series of boxes, and brought a fresh box in a line with the lay, such inclined part d^3, comes between a stud *g*, fixed in the framing *a*, and one of the studs *e*, to hold the series of boxes steadily. When the rods *d*, are both raised above the studs *e*, as indicated by one of them, the series of boxes is free to be rotated by hand or otherwise.

By these means greater steadiness is obtained in working rotary shuttle boxes, to admit of greater speed being employed in giving motion to the looms.

The patentees claim, "the adaptation or combination of means for effecting steadiness of action when giving motion to rotary shuttle boxes of looms, substantially as explained."

To JOHN ABRAHAM, *of Birmingham, for improvements in machinery for coining.*—[Dated 21st April, 1864.]

IN machinery for coining, as ordinarily constructed, the blanks to be made into coins are cut out in one machine, and they are milled or marked on their edges in another, and the milled or marked blanks are afterwards stamped or impressed in a third machine or press. Now this invention consists in arranging machinery for coining, whereby the blanks to be made into coins are cut out, and the edges of the blanks milled or marked in the same machine.

In Plate V., fig. 1 is an end elevation of the machine for cutting out blanks for coins and for milling the same. Fig. 2 is a longitudinal section; and fig. 3 is a transverse section of the same; fig. 4 represents a portion of the machine as hereinafter explained.

The metal from which the blanks are to be cut is fed into the machine by means of the pair of vertical rollers *e*, *e*, (fig. 3) and the waste metal is removed from the machine by means of another pair of vertical rollers *f*, *f*, at the opposite side of the machine. The sheet metal being fed into the machine is marked *g*, and the waste metal being removed from the machine is marked *h*. The feed and delivery rollers receive an intermittent rotatory motion. The metal *g*, is fed by the rolls across a series of three fixed hollow dies *i*, situated in an oblique line one above the other in the bed *k* (fig. 2). Working in a line with each of the fixed hollow dies *i*, is a punch *l*, fixed in the ram or plunger *m*. By means of these punches blanks are cut out from the sheet metal fed into the machine. Each of the hollow fixed dies *i*, communicates at back with a spout or guide *n*, and the blanks cut out by the operation of the punches *l*, pass down the said spouts or guides to grooves *p*, in the periphery of a rotating milling disc or wheel *q*; the bottom end of each of the spouts *n*, opening over a groove in the milling disc. By the rotation of the milling disc *q*, the blanks are carried against the fixed milling plate *r*, and thereby milled, and the milled blanks then fall from the machine. The milling disc *q*, and fixed plate *r*, are of the ordinary construction. The motions of the several moving parts are obtained in the following manner:—*s*, is the driving shaft, provided with fast and loose pulleys and fly wheel. This shaft works in bearings at *w*, *x*, carried by the framing of the machine, and to the end of the shaft *s*, the rotating milling disc *q*, is attached. The driving shaft *s*, carries a bevil pinion *z*, which gears with a bevil toothed wheel 2, on the vertical shaft 3. On the upper end of the shaft 3, is a crank 4, working in, and giving motion to, the slide 5, on the bed 6, of the machine. To this slide 5, the ram or plunger *m*, carrying the series of punches *l*, is fixed by means of the screws 7, and nuts 8. By the motion of the shaft 3, transmitted from the driving shaft *s*, by means of the bevil gearing *z*, 2, the crank 4, on the end of the shaft 3, gives a reciprocating sliding motion to the slide 5, and through it to the ram or plunger *m*, and punches *l*. The intermittent rotatory motion of the feed and delivery pairs of rolls *e*, and *f*, is effected by means of the mechanism represented separately in fig. 4. On the vertical shaft 3, is an excentric 10, the connecting rod 11, of which excentric has at its end a bell-crank lever 12, turning loosely on the axle of one of the rolls *f*, *f*. On the axle of the roll *f*, upon which

the lever 12, turns, a ratchet wheel 13, is fixed, and on the axle of one of the rolls *e*, a similar ratchet wheel 14, is fixed. An arm or lever 15, turning loosely on the axle carrying the ratchet wheel 14, is connected by the rod 16, to one of the arms of the bell-crank lever 12. On the said lever 12, is a pawl 17, engaging with the teeth of the ratchet wheel 13, and on the lever 15, is a pawl 18, engaging with the teeth of the ratchet wheel 14. By the motions of the excentric 10, connecting rod 11, lever 12, connecting rod 16, and arm or lever 15, the pawls 17, 18, are made to work the ratchet wheels 13, 14, and thereby give the necessary intermittent motions to the two pairs of rolls *e*, and *f*. The distance between the pairs of rolls is adjustable. In order to prevent the scrap metal from sticking to the punches *l*, when they make their return motions, immediately in front of the fixed hollow dies *i*, a plate or releaser, marked 22, in fig. 3, is placed. The releaser has three holes 23, in it of the size of the punches *l*. On the retiring of the punches *l*, if the scrap metal should stick thereto, it is removed by coming against the plate or releaser 22.

The patentee claims, "arranging or combining, substantially in the manner described and illustrated, the parts of machinery for coining, so that the cutting out of the blanks, and the milling or marking of their edges, are effected in the same machine."

To JAMES DODGE, *of Waterford, Saratoga County, U.S.A., for improvements in apparatus for hardening saw blades and other plates or sheets of steel.*—[Dated 23rd April, 1864.]

THIS invention consists in the employment of two hollow metal boxes or chills, with a thin steel or other metal plate or cover on the face side or side in contact with the plate or sheet to be hardened. These boxes have partitions of metal formed inside, so as to sustain the thin steel plates or covers. The covers are fitted water-tight on to the boxes or chills, and are cooled by a current of water circulating through them in a zigzag or any other manner, as may be arranged with the partitions above referred to. One or other or both the boxes or chills are also fitted at the back or outside with india-rubber or any other yielding or elastic substance, which is interposed between the box or chill and the supporting framing. It is obvious that these boxes or chills may be made of size or shape to suit the article to be hardened. The chills are placed edgewise in a strong frame, and the saw blade, plate, or sheet of steel to be hardened, is placed, whilst in a heated state, between them, whereupon the two boxes are caused to approach and compress the article between them, until the blade or plate has attained the proper temper or hardness.

In Plate V., fig. 1 is a transverse vertical section of the improved apparatus for hardening saw blades and other plates or sheets of steel; and fig. 2 represents, in plan view, one of the chills, with the middle portion broken away. A, is a cast-iron frame, provided with supporting brackets B, bolted thereon; at each end of this frame, on the lower and inner side thereof, is cast a small supporting ledge or rib *a*, upon which the extremities of chills C, C¹, rest, they being made to fit easily inside the frame A. D, is a cam shaft situate inside the frame A, and carried

in a bearing at each end thereof; it is provided with a lever handle on one end outside the frame, and has keyed on to it (inside the frame) the cams or excentrics F, F, F, which bear against the back of the chill C, and forcibly press it, when the handle is partially turned against the face of the chill C¹. This chill is supported at the back by the frame A, but between it and the frame there is interposed a sheet of india-rubber G, which allows the chill to conform, under pressure, to the slight irregularities of the plate or saw blade to be hardened, and also to compensate for any contortion or twisting of the chill, arising from the expansion produced by the heat of the plate or saw blade. The construction of these chills will be readily understood on referring to fig. 2; they each consist of a hollow cast-iron or other metal box C, open on one side, and provided internally with a number of ribs or partitions *c*, *c*. The edges of these partitions are flush with the edges of the box, and serve to support and retain in a firm and solid manner a thin steel plate or cover, which forms the face of the chill, and which is attached, by screws or otherwise, to the box C, the joint being rendered water-tight. In some cases hollow cast-iron chills may be used with water circulating through them, and having the chilling face supported by studs cast therein, the thin steel face plate or cover being dispensed with. By being thus supported at the back, the chilling faces or plates are prevented from giving way under the pressure which is exerted against them. *e*, and *f*, are flexible or other pipes attached to each chill, for allowing of a free circulation of cold water through them, so as to keep them cool, the water taking a zigzag course between the partitions *c*, as shown by the arrows; openings being made through the ends of the partitions to admit of the unimpeded flow of the liquid. In using this apparatus, the saw blade or sheet of steel to be hardened is first heated to the proper temperature, and then dropped between the contiguous faces of the two chills C, C¹; after which the chill C, is pressed firmly against the heated metal by the action of the cams or excentrics F, so as to compress the same between the cold surfaces of the chills; the elastic or yielding backing of the chill C¹, enabling it to adjust itself to any irregularities in the plate or sheet of steel to be hardened.

The patentee claims, "First,—the general construction and arrangement of apparatus for hardening saw blades and other plates or sheets of steel, as described. Second,—the application and use to and in the hardening of saw blades, and other plates or sheets, of hollow chills, through which cold water is allowed to circulate, in combination with a backing of india-rubber, or other suitable elastic or yielding material, as described. Third,—the application of a backing of india-rubber, or other suitable elastic or yielding material, behind one or both of a pair of metallic chills, for the purpose described. Fourth,—the peculiar construction of chills for hardening saw blades and other plates or sheets of steel, with a thin chilling face of steel or other metal, which is supported or sustained by ribs, studs, or other means of support, as described. Fifth,—the placing of chills, through which water is allowed to circulate, and which are intended to be used in the hardening of saw blades, and other plates or sheets of steel, with their chilling faces in a vertical or nearly vertical position, for the purpose described."

To SIR CHARLES FOX, *of New-street, Spring-gardens, for improvements in causing adhesion of the driving wheels of locomotive engines and other carriages to or upon the rails upon which they run,—being partly a communication.*—[Dated 26th April, 1864.]

THIS invention consists in a novel mode of applying electro-magnetic force or attraction, and a novel construction of apparatus to be used in such application, for the purpose of preventing the wheels from skidding on the rails.

In Plate V., fig. 1 shows, in side view, two driving wheels of a locomotive engine, with the apparatus applied thereto. *a, a*, are the driving wheels, and *b, b*, arched or deflected belts, the insulated wires of which completely surround the wheels at the part represented. The belts are held by slings *c, c*, to the frame of the engine, and to prevent swaying about and touching, the wheels are firmly braced by stays. *d, d*, are screw adjustments to the slings for regulating the height of the belts above the rail. The ends of the wires constituting the belts are carried to an ordinary "quantitative" battery situate at any convenient place upon the engine. The axles uniting these wheels with the respective wheels on the opposite side constitute armatures, and each pair of wheels, with their deflected belts and axle uniting the wheels, is thus formed into a magnet, or exercises magnetic adhesion, to or against the rails, which, by the deflected form of the belts, has the greatest effect at the apices or points of contact between the wheels and the rails.

Fig. 2 represents, in dotted lines, in side elevation, two driving wheels, furnished with the deflected belts, both wheels placed as for and on one side of an engine, and the two belts and wheels being connected or combined into one system by a bar or armature *h*, which latter is shown in black lines, and illustrates more particularly the improvements secondly above set forth. Fig. 3 is an end view of one of the wheels to correspond. The bar or armature *h*, is made of a soft iron tube, about 2½ or 3 inches in diameter, and filled with small pieces of round soft iron, steel, or iron filings, and the ends fit with a socket fitting upon dowels or projections upon the saddles B, B, over the naves C, C, of the respective wheels, and which saddles are preferred also to be of soft iron, and to be let into grooves formed for their reception, so as to increase the surfaces in contact. The wheels are to be insulated by short tubes D, D, (fig. 2) of brass around the axles. The armature *h*, is to be covered with a coil of insulated wire in connection with a battery, and applied to the naves, as above described. This will constitute one system or combination on one side of the engine or carriage, and, together with the other or second system or combination on the opposite side, and with the two axles or cross armatures, will constitute a compound magnet of greatly-increased power.

Figs. 4 and 5 represent an end elevation and cross section at z, z, of the mould or apparatus employed for banking up or winding the wire to form the belts in the deflected form. This mould consists of two main pieces *m*, and *n*, separable from each other, for the purpose of removing the belt when formed, but used together while the winding proceeds; for which purpose it is mounted on axes to turn on frames *o, o*.

Fig. 6 is an end view of part of the piece *m*, as seen in the direction of the arrow in fig. 4, and shows particularly the pins *p*, *p*, at the ends for keeping the wires from falling, which they would do if not supported, and to prevent which the ends of the belts are to be packed up with short pieces of the wire extending across the ends, nearly but not quite to the full width of the ends, and placed to fill up the spaces left in forming each layer before the next succeeding layer is banked upon it. Marine glue or shellac is to be applied to the wire as it is wound on to the mould, and this will serve to hold in position the short packing lengths or pieces of wire above described: *s*, *s*, are clips or guides applied at the sides of the mould, and these also are for keeping the wire in its place while winding, and are removeable so as to be applied to either piece *m*, or *n*, according to the direction in which the belt is being coiled, that is to say, right to left, or left to right, in fig. 4, corresponding with bottom to top, or top to bottom, in the former figures. The insulated wire is to be wound from off a reel or drum, at a convenient distance, the glue or shellac being applied so as to surround and coat every part; and when the belt is formed, and further payed over and coated with the glue, it is to be taken from off the mould; the pins *p*, and clamps *s*, being first removed therefrom. It is then to be secured by a temporary binding of strips of cloth, to hold it in shape, and to be baked in an oven at a temperature of about 170° Fahr., for about eight or ten hours, to drive out the moisture. The temporary binding strips may then be removed, and the belt covered with waterproof cloth, or any other water-repellent substance, and sometimes a thin sheathing of brass may be added. The belt is then complete. It is to be understood that each belt is to have the two ends of the continuous wire left out for connecting with the battery.

The dotted lines in fig. 2 illustrate the feature or division of the invention lastly above set forth, both in respect of the combination referred to, and otherwise. *w*, is one of a pair of the armatures, with pendent ends *w**, *w**, and a corresponding armature is to be used on the opposite side of the engine or carriage. If the armatures be supposed to rest upon, or be supported by, the saddles B, B, then the figure illustrates the combination with the deflected belts; but if the armatures be not supported by the saddles, but are supported independently from the frame of the engine or carriage, then the dotted lines alone illustrate the absence of the combination referred to. In either case, excepting at the extremities of the pendents *w**, *w**, the armatures should be bound or covered with a coil of insulated wire, extending over the whole of their length.

To THOMAS HUNTER HOLDERNESS *and* HENRY JORDAN, *both of Liverpool, for improvements applicable to the construction of ships or other navigable vessels, the hulls of which are built with metallic frames and wood planking; part of which may be applied to vessels constructed entirely of wood, or with wood frames and planking, and iron deck beams.*—[Dated 23rd April, 1864.]

THE first part of this invention consists in applying iron or other suitable metal in place of timber in the construction of the waterways

and bulwarks to ships or other navigable vessels, the hulls of which are built entirely of wood, or with wooden frames and planking, and iron deck beams, or with metal frames, deck beams, and planked with timber up to the gunwale.

In carrying out this invention, a vertical stringer plate is carried round the outer side of the vessel's frame, the upper edge of which is in line with the top of the deck beams, or nearly so, and a horizontal longitudinal stringer plate is carried on the top of the deck beams right round the vessel, for forming the bottom of the waterway. These two lines of stringer plates are rivetted together by an angle iron, or by having the edge of one line of plates turned to the required angle. The horizontal stringer plate has rivetted thereto two L or angle irons, which run parallel to each other, one of which line of angle irons may be used to rivet the foot of the metal bulwarks to, and the other to receive the abutments of the sides and ends of the deck planks. The lower limbs on the L or angle irons are turned towards each, and placed sufficiently apart to form the waterway. The top of the bulwarks is turned inwards, or an angle iron is rivetted along the upper edge thereof, to which can be attached a wooden rail. The bulwarks are fitted internally with metal stays, the feet of which are secured to the inner line of angle or L iron or other metal; or the plates forming the bulwarks may be turned in at the bottoms, to form the bottom of the waterway, in which case the outer line of angle iron on top of the waterway would be dispensed with; or the bulwark plates may be extended sufficiently downwards to form the vertical stringers, and be secured to the frame of the vessel, and the plates of the waterways may be secured to the bulwarks by angle iron, or by having the outer edges of the waterway plates turned at an angle to allow of their being rivetted to the bulwark plates; or the vertical stringer plates may be carried sufficiently upwards to allow the bulwark plates to be rivetted thereto. In place of the bulwark stays stanchions of angle or T iron may be used.

By this improved system of metal waterways and bulwarks, iron or other metal may be used in the construction of the poops and top-gallant forecastles of ships or other navigable vessels built of wood, or with metal frames and wooden skins.

This invention further consists in attaching the wooden planking of iron-framed vessels to the frames by means of bolts driven from the inside and rivetted on the outside, which mode not only facilitates the work of fastening, but is less costly than when screwed bolts and nuts are used, and will be found a far superior mode of fastening; as by this improved arrangement the bolts can be the full size of the holes in the metal frames, whereas the screwed bolts now used are obliged to be of a less diameter than the holes through which they pass, to prevent the thread of the screw being injured in driving.

The figure in Plate V. is a vertical transverse section of a portion of a vessel's side and deck constructed of wood, with the improved metallic bulwark and waterways attached thereto. *a*, is the external skin or planking of wood, applied longitudinally in the ordinary way; *b*, is the vertical wood frame; *c*, an iron knee; *d*, a deck beam, to which is bolted *e*, the longitudinal stringer forming the bottom of the waterway, and to the outer edge of which is attached the vertical metal stringer plate *f*. To the upper edge of this plate is rivetted the iron or other

metal bulwarks *g*. *h*, is an angle iron, against which the edge of the deck planks abut, and which is rivetted to the horizontal stringer plate on the top of the deck beams, and forms the inner side of the water-ways; *i*, angle iron, which, by means of rivets, connects the horizontal and vertical stringer plate together; *k*, is an angle iron rivetted along the top of the bulwarks, and above which is mounted *l*, a wooden rail; *m*, are metal stays for bulwarks; *n*, bolts for attaching the external wooden skin to the metallic frames, which are driven from the inside, and clenched or rivetted on to a washer on the outside.

The patentees claim, "First,—the application of iron or other suitable metal in place of timber, in constructing waterways and bulwarks to such ships or other navigable vessels, the hulls of which are built entirely of wood, or with wooden frames and planking, and iron or other metal deck beams, or with iron or other metal frames and deck beams planked with timber up to the gunwale, in the manner and for the purposes described. Secondly,—the application of poops and top-gallant forecastles, constructed of iron or other metal, to such ships and other navigable vessels, the hulls of which are built of wood, or with metal frames and wooden skins, in the manner described. And, lastly, in attaching the wooden planking to iron or steel-framed vessels, by driving the bolts from the inside and rivetting them on the outside, in contradistinction to the driving of the bolts from the outside and rivetting them on the inside, and to screw bolts driven from the outside and having the nuts applied thereon from the inside, as now commonly practised."

To William Isaac Meacock, *of Liverpool, for improvements in the construction of anchors,—being a communication.*—[Dated 30th April, 1864.]

This invention relates to certain improvements, whereby greater holding power is obtained than by the ordinary anchor, in consequence of two flukes acting at once independently of each other.

In Plate V., fig. 1 represents a plan view of the anchor, and fig 2 a side view of the same. *a*, is the shank, with the solid head *b*, enlarged on each side, to form the shoulders *c*, *c*. *d*, *d*, show the internal angular faces of the shoulders for the bearing surface of the palms of the flukes *e*, *e*, which are connected to the shank by the bolt *f*, on which they swing; *g*, represents a shackle for the purpose of fishing the anchor.

The patentee claims, "the general construction, arrangement, and combination of parts, substantially as herein specified."

To James John Miller, Jun., *of Clarendon-place, Vassall-road, Brixton, for improvements in steam engines and pumps.* — [Dated 5th May, 1864.]

This invention is peculiarly applicable to small steam engines used for pumping and other purposes, and consists in constructing the piston

and cylinder in such manner that, by the rotation of one of them, and by having passages in the piston, the induction and eduction ways shall be opened and closed.

In Plate VI., fig. 2 shows, in vertical section, the cylinder, piston, and other parts of the steam engine constructed according to this invention; and fig. 2 is a transverse section taken at the line 1, 1, fig. 1. *a*, *a*, is the steam cylinder; a^1, is the induction port, and a^2, a^2, are the eduction ports: they are, it will be seen, placed in the centre of the length of the cylinder. *b*, is the piston: it is shown without any packing, as, in small engines, packing will be found to be unnecessary. b^1, b^2, are steam passages or grooves formed in the piston. *c*, is the piston rod, passing out through a stuffing box on the cylinder cover; *d*, is an arm fixed on the piston rod; its end enters the cam groove *e*, shown in plan at fig. 3, and formed in a piece secured to the framing or foundation of the engine. This arm *d*, will, as the piston *b*, travels to and fro in the cylinder, cause it to rotate through a small part of a circle, first in one direction and then in the other, as the end of the arm follows the course of the cam groove *e*; and this partial revolution of the piston will bring the passages b^1, and b^2, in the piston alternately up to the induction passage a^1, and when one of them is opposite to the induction passage, the other will be opposite one or other of the eduction passages a^2, a^2. With the parts in the position shown at fig. 1, the passage b^1, is opposite the induction passage a^1; and the steam passing along it is led to the left hand end of the cylinder, when it acts to force the piston to the other end of its stroke, where it is turned partly round, and the passage b^1, is brought opposite one of the eduction passages a^2, whilst the passage b^2, comes up to the induction passage and takes steam to the other end of the cylinder to bring back the piston, and so the work goes on. *f*, is a lever used in starting the engine when it happens that the piston has stopped near one end of its course, but before the reversal in the passages in the piston has been completed. The lever *f*, is keyed on a bar *g*, of circular section; it passes through a stuffing box in the end of the cylinder, and the portion within the cylinder has a feather upon it, running from end to end of the bar. In the piston is a hole to receive the rod *g*, and its feather, and the space allowed for the feather is such that the rotatory motion of the piston can take place when the lever *f*, is in a central position, without moving the rod *h*; but if the engine happens to stop when the partial rotation of the piston is incomplete, it can readily be put over by means of the lever *f*. When adapting the invention to a force pump which is to be worked by the engine, the plunger is affixed to the piston rod *c*, and the pump barrel set in a line therewith.

Although these engines are intended especially to be worked by steam, still they may be worked by water, air, or other fluid under pressure. Or the machine can be used as a pump, by connecting the piston rod with a crank driven by manual or other power, or otherwise, by giving motion to the piston, and, further, by making the induction and eduction pipes the suction and supply pipes of the pump.

To Henry Bennett, *of Wombridge, Shropshire, for improvements in puddling iron, steel iron, and steel, and in apparatus or machinery for facilitating the operation of puddling.*—[Dated 23rd April, 1864.]

This invention consists, firstly, in submitting pigs of iron to a strong heat prior to their introduction into the body of the furnace to be puddled; this is effected by placing hollow bars, with water running through them, over the fire-grate, or over the body of the furnace, at a distance of some six inches from the crown: upon these water bars are laid the pigs, introduced through doors in the end of the furnace above the fire door; and as one heat of metal is being bloomed or balled, these pigs are being reduced almost to a molten state; the heat being drawn, the pigs are removed into the position in the puddling chamber, where they are in turn to be puddled; but this operation of previously heating them will save from twenty to thirty minutes in the operation of puddling each heat, and, of course, a corresponding saving of fuel is also effected.

Secondly, the invention consists in placing a quadrant guide, supported in suitable carriers, upon the top of a puddling furnace: around this quadrant guide moves a radial bar from a pivot at the centre of the circle, of which the quadrant forms a portion: from the bed plate supporting the quadrant on the top of the furnace is supported a long rod hung on friction rollers, from which runs a connecting rod which gives motion to the radius rod travelling round the quadrant, and also supports the puddler's rabble.

In Plate VI., fig. 1 is a vertical section, and fig. 2 a plan, of a furnace fitted with the improved puddling apparatus; and fig. 3 is a plan of a similar furnace fitted with another form or modification of the improved puddling apparatus.

In figs. 1 and 2, 1, is the furnace bed; 2, a quadrant guide, supported on carriers 3: around this quadrant guide works the radial bar 4, from a pivot at 5, the centre point of the quadrant. 6, is a rod or bar running on friction rollers 7, which bar is carried by the standards 8: this bar travels over two or more furnaces, having the same apparatus connected to them, and thus several furnaces are worked by the same engine power simultaneously, the rod 6, being connected to the engine by a crank, or in any other suitable manner. 9, is a rod suspended from the rod 6, and attached to the radial bar 4; so that as the bar 6, works with a reciprocating motion backwards and forwards in a line with the body of the furnace, the radial bar 4, partakes of the same motion, whilst, by its motion round the quadrant, a circular motion is also insured; thus, through the connecting rod 10, hung from the radial bar 4, the puddler's rabble 11, is constantly worked in a rectilinear and also a circular motion, imitating as nearly as possible the movements of the human arm. The rod 12, is attached at one end to the quadrant slide, and at the other to a crank 13, upon which crank is the rod 14, and vertical rod 15, upon which is fixed the pinion 16, working into, and driven by, a worm 17, upon a revolving shaft 18, by which revolving shaft motion is given off from the engine. This forms the change or reversing gear, bringing back the quadrant slide, and with it the radial bar 4, when they have reached either end of the quadrant. The rod 14, is in connection with similar change gear upon the next furnace, and,

by means of a bell crank fixed at any suitable point upon this rod, the connection being upon the opposite arms of the crank, a reciprocating motion is maintained. Any number of furnaces may thus be connected together, and worked by the same power simultaneously.

Fig. 3 represents a modified form of the apparatus, in which the quadrant and several other portions of the mechanism are dispensed with. In this form of apparatus the rod or bar 1, by which the power is derived from the engine, has a bent lever rod 2, suspended from it at the point 3: the rod 2, works in a slotted bar 4, and supports the rabble. The slotted bar 4, is hung upon a pivot at 6, and by the attachment of the rod 7, (worked by the reversing gear) to the end 8, of the bar 4, a circular reciprocating motion is imparted to the bar, and it moves in an imaginary arc of a circle, of which the point *b*, is the centre. Thus the circular reciprocating motion is obtained, whilst by the connection of the bent lever 2, (carrying the rabble) to the bar 1, at the point 3, rectilinear reciprocating motion is imparted to the rabble. Several furnaces may be worked simultaneously by this system, by putting them in communication in the same manner as explained for the apparatus shown in figs. 1 and 2.

The patentee claims, "Firstly,—the improvement in puddling iron, steel iron, and steel, by submitting the pig iron to a strong heat before puddling, as herein described. And, Secondly,—the improvements in apparatus or machinery for facilitating such operation of puddling, substantially as herein more fully set forth and specified."

To JAMES EDWARD DUYCK, *of Stamford-street, Blackfriars, for improvements in distilling and purifying petroleum oils and other hydrocarbons, and in apparatus employed therein.*—[Dated 22nd April, 1864.]

THIS invention consists in distilling and purifying petroleum oils and other hydrocarbons, by means of heat, by the introduction of steam (by preference superheated steam) into the body of the oil, by mixing with the oil, when vaporized, chlorine gas, and by bringing in contact with the vapours and gas moist steam, the whole of which are then condensed and drawn off. In some cases the moist steam is dispensed with. The invention also consists in purifying petroleum oils and other hydrocarbons by bringing the vapours of such oils and hydrocarbons in contact with chlorine gas.

The figure in Plate V., is a sectional elevation of the apparatus employed. *a*, is a furnace; *b*, *b*, are flues carried round a boiler or vessel *c*, for containing petroleum, or other hydrocarbon or material for producing hydrocarbon; *d*, is a steam supply pipe; *e*, *e*, are pipes open at bottom for conveying steam to the lower part of the boiler; *f*, is a coil, for superheating the steam; *g*, is a pipe, for carrying off the vapourized products from the boiler; *h*, is a pipe leading from a chlorine retort *i*, for bringing chlorine gas in contact with the vapourized products; or, instead of the retort, a gasholder is sometimes used, for containing a supply of chlorine gas, and pressure is applied to force the gas from the holder through the pipe *h*. The

gaseous products issue from the pipe *g*, into a condenser and coil, held in a cistern containing cold water, or other cooling agent, and the condensed gases are drawn off in a liquid state from the outlet of the coil.

The patentee claims, "First,—distilling and purifying petroleum oils, and other hydrocarbons and substances for producing hydrocarbons, by bringing the vapours driven off therefrom by heat in contact with chlorine gas. And, Secondly,—the arrangement of apparatus hereinbefore described."

To CHARLES JAMES RICHARDSON, *of Kensington-square, for improvements in arranging steam boiler and other furnaces, in order to render them more suitable for burning petroleum and like oils.*—[Dated 4th May, 1864.]

IN arranging furnaces, in order to render them more suitable for burning petroleum and like oils, the bed or lower part of a furnace is constructed in such manner as to receive compressed charcoal or other porous matter, either as a single complete layer or in sections, so as to allow of atmospheric air passing between the sections. Underneath the bed, or sections of the bed, there is a space, or spaces, supplied to any required height with petroleum or like oil, and the petroleum or oil, or the vapour thereof, percolates upwards through the porous material in the bed, or sections of the bed, of the furnace: and it burns at the surface of such porous material. By these means petroleum and like oils may, with safety and with great utility, be burned as fuel in steam engine and other furnaces.

In Plate VI., fig. 1 is a plan of grate with four bars; fig. 2 section through the centre of grate; fig. 3 section of grate through the middle of fire-bar; and fig. 4 is a transverse section on the line C; fig. 5 section of grate on the line D, fig. 1. *a*, *a*, are the oil chambers; *b*, the oil cistern, with five openings to admit the oil into chambers; *c*, the space filled with water from the boiler; *d*, the vapour chamber; *e*, the pipe, conveying the vapour to the perforated tube *f*, and permitting its escape; *g*, air tubes conveying air to mix with the vapour. Fig. 6 section of one bar, showing the filling in with the porous material; *h*, the porous material; *i*, the pipe by which the oil enters the grate—tap No. 1 regulating the flow; *k*, the pipe by which the oil is drawn off; *l*, glass indicator, showing height of oil in the grate. Two lines are drawn across it: when the oil stands at the upper, the fire will burn fiercely; when at the lower, the grate is fully served. *m*, is a tube conveying water from the boiler to the grate, by preference from the upper part of the boiler; *n*, ascending tube, returning water from the grate to the boiler, by preference to the lower part of boiler; *o*, is the filtering tube to boiler, the water passing through grate; *p*, *p*, bars attached to the boiler, and permitting the grate to slide over them.

The operation is as follows:—The oil chambers are packed tightly with porous material: the oil enters quickly, ascends, and completely soddens the porous material, which soon shows an oily surface. When paper pressed upon it becomes saturated it can be lighted. The oil on the

surface vapourizes as soon as it becomes warm, the vapour takes fire, and will continue to burn as long as there is any oil in the chambers: if sufficiently hard, the porous material remains uninjured: the flame is continued at pleasure by admitting the oil. The vapour chamber is placed in the hottest part of the grate—it collects and forms vapour; this is conducted to a perforated tube and allowed to escape; taking fire from the flame of the grate, it gives additional heat and tends to burn the smoke: air is admitted to aid the operation. To prevent the grate getting too hot, as well as to obtain all the heat given out by the combustion of the oil, the water from the boiler circulates through the grate and returns. *q*, fig. 2, is a shield to prevent the air and vapour tubes becoming too hot. The porous material goes to the bottom of the oil chambers; it sucks up the oil, otherwise the latter would boil and produce too much vapour, which would escape to the vapour tube. The kind of porous material to be used, its thickness and depth, whether it should be of one, two, or more sorts, must be according to the work required, and to the nature of the oil. There are several kinds of porous material—thin slices or blocks of porous bricks, pumice-stone, lime, charcoal, or moulded carbon, bath-brick, natural or artificial porous stone, loam, or sand core (used in foundries), lime, charcoal, or such like in powder—either placed on or between solid sponge, when placed below other solid material: the thinner and more open the material, the fiercer the combustion and the greater the smoke. Mineral salt, with a thin top of moulded carbon or charcoal, makes a good packing, but the salt by itself soon burns to cinder and will not last. The bottom of the oil chambers inclines downwards to the cistern, to allow any thick matter to descend to be taken out. When the flame is to be extinguished, the cover is to be put over it, the vapour being permitted to burn itself out. The upper surface of the grate should be six or seven inches only under the boiler.

The petroleum oils used in the apparatus should be the Pennsylvanian, Wallachian, Rangoon, and the English coal crude oil. The Rangoon —as thick as half melted snow—requires to be mixed, the first one or two gallons, with a little petroleum spirit, and well stirred to make it fluid. When the grate is well warmed, the oil in its natural state can be put into the cistern in any convenient way.

To William Crofts, *of Herne Bay, for improvements in the means and apparatus used in the propagation of oysters.*—[Dated 25th April, 1864.]

This invention relates, in the first place, to the use of tanks or vivaria in which the oysters are deposited for the purpose of breeding. Water is allowed to flow constantly through these tanks. The oysters are placed in rows in an inclined position, with their mouths upwards, and supported in this position, at intervals, by long narrow tiles, about half an inch thick, running transversely across the tanks. These tiles are made of a mixture of blue estuary clay, calcined oyster shells, cracked cockle and oyster shells, and Roman cement, baked in the sun or otherwise hardened. They are provided with lugs or projections at their back surfaces, for holding them up at the proper angle for the support

of the oysters. These tiles are indented with grooves, arranged to subdivide them into squares, and perforated with holes, to increase the facility with which they can be separated into parts; should the young oysters adhere to their surface, they are further perforated, the holes being filled with cork, or other substance suitable to induce the deposit of the spat. Above and over these oyster tiles are placed spat or brood collectors, which consist of long round bars of wood, also traversing the bars transversely, and supported at each end by chairs or dogs, so as to raise them slightly over the oyster tiles. These collectors are perforated for the reception of bunches of broom, heather, coir, cork, or other such material as may induce spat or brood of the oyster to adhere. These bunches radiate from a centre, or are otherwise arranged to form a proper attraction. These collectors may be placed in a tideway, near to or over ordinary oyster beds, for the cultivation of the spat, if required.

This invention further has reference to acclimatisers or water tanks, vivaria, or receptacles for the reception of oysters, the temperature of which can be regulated or altered by ordinary mechanical appliances, and the proportion of salt water and fresh also varied by the same means, so that it will not be necessary for the oysters to be taken at once from the sea or returned to their natural element, as they can be acclimatised to the water in the tanks by gradual stages.

This invention also relates to a vermin collector for taking up starfish and other such things from the oyster beds. It is formed of two wheels on a spindle, connected by rollers, being armed with bunches of coir, or such bristly substance, or hooks. The collector is dragged over the oyster beds, and gathers the vermin, which it deposits in a vessel suspended from the spindle for that purpose.

This invention also relates to spat collectors, in the shape of four rectangular tiles, radiating from a hollow boss in the centre (in cross section, in the form of a cross) and perforated with holes, which are filled with cork, kamptulicon, or like material, to which the spat will readily adhere. These are lowered down in a tideway, and taken up again when required to be examined, or they may be used in the vivaria instead of in the tideway.

This invention also relates to a circular case or frame of wicker or stake work, puddled and lined with tiles, and covered over at the top, to be placed in a tideway or on the beach. In this will be placed oysters for breeding, and the water will be changed at every rise and fall of the tide; also fresh water can be mixed with the salt water in these receptacles, by means of a pipe from the shore. In operating with the above apparatus, it can be done either with or without the action of voltaic electro-galvanism.

With reference to the tanks or vivaria in which the oysters are deposited for the purpose of breeding, water is allowed to flow constantly through the tanks, it being filtered as it passes in and aërated by falling from a height into the tank.

In Plate V., fig. 1 shows a vertical section of a vivarium, which will elucidate the principle of the invention. A, is the upper receptacle for salt water, which runs through perforations in its sides into the vessel B, which is filled with some proper filtering medium. Through this the water percolates until it reaches the bottom, rising between two plates C,

and falling over the top D, on to a spreader I, for aërating the water, which passes thence into the larger part of the tank E; in this tank are placed tiles, or such substances as have been described, for collecting the spat or young from certain oysters deposited therein. Fresh and hot water is mixed with the salt water, as required, by means of pipes F, F, which are carried to the bottom of the filtering tank. As the water is drawn out of the vivarium at bottom, any spat not deposited upon the collectors is caught upon the gravel, or other substance, deposited in troughs G, G, G, G, from the compartments below which the waste pipes lead. O, is the spill water. In large vivaria, the oysters are placed in rows in an inclined position, with their mouths slanting upwards, and are supported in this position, at intervals, by long narrow double tiles, about half an inch in thickness, and made as above described, running transversely across the tanks. Fig. 2 shows this arrangement in elevation. Fig. 3 shows a portion on an enlarged scale. Above and over these oyster tiles are placed the spat or brood collectors H, which consist of long round bars of wood. On these bars of wood are strung collectors, also traversing the beds transversely, and supported at each end by chairs or dogs, so as to raise them slightly above the oyster tiles. These collectors can be employed in the tideway near to ordinary oyster beds for the collection of spat or brood, if required; they may also be anchored in position, instead of being supported by dogs. Secondly, with reference to acclimatisers, water tanks, vivaria, or receptacles for the reception of oysters are provided, the temperature of which can be regulated or altered, and the proportion of salt water and fresh water also varied, so that it will not be necessary for the oysters to be taken at once from the sea or returned to their natural element, as this can be acclimatised to the water in the tanks by gradual stages.

Fig. 4 represents an end elevation of a vermin collector, for taking up starfish and other such things from oyster beds. It is formed of two wheels L, L, fixed on a spindle K, and connected by rollers arranged round within the circumference of L; these rollers are furnished with bunches of coir M, or such bristly substances, or alternately with hooks N. This apparatus is further provided with a guard P, behind, to keep the vermin up against the hooks N. The collector is dragged over the oyster beds in the manner of a garden roller, and picks up the vermin, which it deposits in a box or vessel R, suspended from the centre spindle for that purpose.

Fig. 5 represents, in sectional plan, a spat collector, consisting of rectangular tiles T, in the form of a cross, with a hollow boss U, in the centre, and disc-like ends V; they are perforated with holes, which are filled with cork, kamptulicon, or such like material. These are lowered down in the tideway singly, or strung, or used in the apparatus herein described, and taken up again when required to be examined.

The last part of this invention is illustrated in fig. 6, representing a vertical section of the beach. A circular frame of wicker or stake work W, lined inside with tiles and covered over at the top, is to be placed in a tideway; in it will be deposited oysters for breeding, and collectors T, for spat. The rising and falling of the tide changes the water in these receptacles; fresh water can also be introduced by means of pipes from the shore. The wicker or stake work may be either ren-

dered water-tight itself, or the hole in the beach in which it is placed may be staked or piled and puddled, and may be considerably larger than the wicker receptacle.

To CHARLES DOUGHTY *and* WILLIAM DRAKE KEY, *both of Lincoln, for improvements in treating a product obtained in refining the oil of cotton seeds.*—[Dated 15th April, 1864.]

THIS invention consists in a method of treating the residuum or mucilage obtained in the refining of cotton-seed oil in the usual manner by means of alkaline lyes. To extract from this mucilage the oils or fatty matters which it contains, the patentees put three tons of the mucilage into a strong, iron-bound, wooden vat, capable of containing six tons, and having a two-inch perforated lead coil round the bottom; they then apply steam to the mucilage, until the temperature is raised to 200° Fahr., and ten pounds of lime to every one hundred pounds of fatty matter the mucilage is found to contain (white or creech lime being preferred), the lime having been first mixed with water to the consistency of cream. The lime is gradually added, and continuously stirred, until the boiling point is reached; the scum and fibre then commence rising to the surface, and, as it appears, it should be removed by skimming with a bowl or ladle with a perforated bottom, so as to allow such fat as may be mixed with the scum to return into the vat. The boiling is continued for six hours after the boiling point has been attained, care being taken that none of the scum, as it rises, gets again boiled in with the mass. At the expiration of the six hours boiling the steam is turned off, and 250 pounds of sulphuric acid (1·850 specific gravity) diluted with 750 pounds of water, is added to each ton of the mucilage, by being poured through a round vessel with a perforated leaden bottom, placed over the centre of the vat, so as to distribute the acid in minute streams over the boiling mass. The contents of the vat should now be violently stirred, rousing well up from the bottom until the whole of the acid is introduced, taking care that it is added gradually, so that the vat does not overflow. More scum will rise during the introduction of the acid, which must be skimmed off as before. Steam is then again supplied, and the mass again boiled for four hours, after which it is left ten hours to subside; when the fat will occupy the uppermost part of the vat, a clear liquor containing chemical matters the centre of the vat, and the sulphate of lime and heavy matters will be precipitated to the bottom. The fat is then drawn off into another vat, containing a dry steam coil, where it is heated to about 100° Fahr., and well washed with water acidulated with sulphuric or oxalic acid, to entirely free it from lime, and then allowed to repose until the water has settled to the bottom, after which the fatty matter is drawn off into casks ready for distillation. The chemical matters in the clear liquor, and those obtained by washing the thick residue from the bottom of the vat after the grease has separated, may either be recovered by evaporation or used as a manure.

The patentees remark, that in place of adding sulphuric acid to the mucilage, muriatic acid may be employed, but not, it is believed, so

advantageously. In distilling the grease obtained by the process, free steam should be introduced into the still immediately after it is charged, to heat the grease up to 212° Fahr. by this means alone before fire-heat is applied. At this point the fire-heat should commence, and when the temperature is raised to 350° the products will begin to come over, and will all come over by the time that 550° to 560° has been reached. The free steam should be continuously used during the whole time of distillation. The products are fit for being made into candles and soap. The pitchy residue will then easily be blown out by the ordinary pipe at the bottom of the still.

The patentees claim, "treating, as above described, the residuum or 'mucilage' from the refining of cotton-seed oil with lime, and then with acid, to extract from it the oils or fatty matters which it contains; also the distilling in the manner described the grease recovered from mucilage, viz., by heating it at the commencement of the process by free steam, and the applying, in conjunction with the free steam, fire-heat beneath the still."

To JAMES CANE COOMBE, *of Swinton-street, Gray's-inn-road, for improvements in the preparation of fertilizing agents for agricultural, horticultural, and other analogous purposes.*—[Dated 15th April, 1864.]

THESE improvements consist in the application of fluorine, in the nascent state, to all or any of those oils which contain plant food, chemically or otherwise, combined with silica or any other earth capable of being acted on by fluorine, so that the fertilisers may be more quickly and efficiently liberated from their, so to say, locked-up condition than they can be by simple atmospheric action or fallow. This is accomplished by employing certain fluorine compounds which are capable of yielding up the fluorine when in contact with the soil, either simply through atmospheric action, or by admixture with certain dry acid manures; as, for example, superphosphate of lime, or any analogous compound. The use of the alkaline fluorides is preferred, especially the fluoride of ammonium, but the fluorides of sodium and potassium are nearly of equal value, and can be more economically manufactured on account of their abundance and comparative cheapness. It is advisable generally to mix the fluoride employed with some neutral body, as ground felspar, or ground coprolites, or indeed anything compatible with the object, and especially those rocks and minerals abounding in phosphates or alkalies, to the extent of from ten to thirty and fifty per cent., with the object of causing a larger diffusion through the soil, and when a more silent and longer sustained action is required. Where, however, a more immediate and decided action is required, the employment of some compatible acid manure will be advantageous, in any proportions, up to fifty per cent. or more of the fluorine if a yet quicker action may be found desirable. These fluorides may be advantageously used in combination with many other well-known manures—in fact, with any that leaves them undecomposed till their application to the soil; for as the principal object sought for is action of the fluorine in the nascent state, all that has

to be obviated is chemical action till their rendition to the soil. Any suitable material may be employed for admixture with the fluoride, by preference using it dry.

The patentee claims, "the use and application of the alkaline fluorides, such as the fluorides of ammonium, sodium, and potassium, either as agents in the manufacture of artificial manures, or for their employment as simple salts, alone or mixed with other suitable materials, as manures or fertilizing agents."

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

January 24th, 1865.

JOHN FOWLER, Esq., Vice-President, in the Chair.

The paper read was, "*Account of the docks and warehouses at Marseilles,*" by Mr. T. Hawthorn.

It was stated that the port of Marseilles comprised five docks in actual use, and one in course of execution. The old dock—or old port, as it was generally termed—constructed about the time of Louis XV., was formed out of an inlet of the sea. It was 1100 yards in length, with a mean breadth of 120 yards; and near the entrance the depth of water was from 21 to 22 feet. The Dock de la Joliette, the first constructed basin of the new port, was 500 metres in length by 380 metres in width. The Dock du Lazaret, which served exclusively for customs purposes, came next; and then the Dock d'Arene; succeeded by the Napoléon Dock, 380 metres in length by 300 metres in width, recently completed by the State, who were at present engaged in the construction of the Dock Impériale, as well as graving docks, which would be executed to the level of the quays by the Ponts et Chaussées, and then be handed over to the "Cie. des Docks et Entrepôts." All these basins were formed by constructing moles in the sea—a pier or breakwater, parallel to the shore, constituting the seaward side of the enclosure. The earthwork for the moles of the Joliette and Lazaret, as well as for filling in the space upon which the magazines and warehouses were built, was taken, for the most part, from a hill immediately to the east of the docks. This hill, of nearly 100 feet in height, might literally be said to have been thrown into the sea—two million cubic metres of *déblais* having been thus employed. The mole Arene was formed with *déblais* from the Rue Impériale—a new street cut through the old town to the level of the new town—which involved the excavation of 1,200,000 cubic metres. Previous to the filling-in of the Lazaret, excavations to the depth of from eight to ten metres were made, in some places, to remove a mass of slimy earth that had accumulated at that part for many years from the residue of old soap works. This earth was so impregnated

with a green coloured matter, that obnoxious gases were frequently given off, producing illness among the labourers.

In the construction of the pier and breakwater an embankment was first formed of hard calcareous stone, mostly taken, in barges, from the islands opposite the port. This stone was sorted in classes, thus:—rubble, weighing from 20 lbs. to 250 lbs. each piece; first class, from 250 lbs. to 1 ton 2 cwt. each; second class, from 1 ton 2 cwt. to 3 tons 15 cwt. each; and third class, from 3 tons 15 cwt. and upwards. The smallest material was used for the core, or hearting, of the embankment, the larger pieces being successfully added. This embankment was levelled* at a height of 2 metres (6 feet 7 inches) above low water, the surface being 7 metres in width, and the slopes having an inclination of 1¼ to 1 in height. At a depth of 8 metres under low water, the width of the embankment was increased to 7·34 metres, horizontally towards the sea, in order to receive the large concrete blocks, placed on it promiscuously, to break the force of the sea. The artificial blocks had a width of 10 metres at the level of low water, and they attained a mean height of 3·8 metres above the same level. On the inside of the pier, a quay, 30 metres in width, was formed of natural blocks, with a wall in front, the latter having its foundations 6 metres below the water line. The embankment had a slope towards the dock of 2 base to 1 in height; and as its formation progressed, it was from time to time solidified by placing on it artificial blocks, in tiers one above the other, by means of a floating crane or derrick. These blocks were generally allowed to remain about three months.

It having been ascertained, by experiment, that blocks weighing 20 tons each, and measuring 10 cubic metres, could not be moved by the most violent sea in the Mediterranean, artificial blocks of concrete were made, of an average weight of 23 tons; their dimensions being 2·4 metres long by 2 metres wide, and 1·5 metre deep. These blocks were composed of two parts of hard, broken limestone to one part of cement; the cement consisting of five parts of sand to one of lime. These materials were mixed in portable iron cylinders, made to rotate by means of a belt connected at pleasure with a steam engine, which also drove the stones for mixing the cement. After the concrete had been well worked, the mixture in the cylinders was emptied into wooden moulds, which could be detached from the blocks. The moulds were so constructed as to form a groove at each end of the blocks, for facilitating the lifting and setting of them. The contents of each cylinder were beaten down by two men—an operation which occupied half-a-day for each block. The moulds were allowed to remain for at least three days before the cases were removed; but the blocks were not considered to have attained sufficient solidity and hardness, for those that were to be thrown promiscuously into the sea, until after a lapse of three months, and for those that were to be employed in forming the foundations of the piers and quays, until after a period of six months. The blocks attained, in course of time, a hardness almost equal to that of stone; those first used, about sixteen years back, being very little worn by the action of the waves. The cost of the

* The level of the Mediterranean varied at Marseilles about eighteen inches, according to wind and other influences.

blocks was 12*s.* 8*d.* per cubic metre, or, including setting and other incidental expenses, 15*s.* 10*d.* per cubic metre. The entire cost of the breakwater had amounted to from £290 to £310 per lineal metre.

In the construction of the quay walls of the docks Lazaret, Arene, and Napoléon, the system of building on artificial blocks, somewhat similar to the inside of the pier, was adopted. At 6 metres under the level of low water, an embankment was formed of second and third class stones, having a base of from 8 to 9 metres in width, and an inclination at the sides of 1 to 2. Upon this embankment, and up to the level of the water, four rows of artificial blocks were placed longitudinally, side by side, making a total height of 6 metres, with a width on the top of 3·4 metres. Two rows of blocks were usually placed on these, to consolidate the embankment, and were allowed to remain for about six months. When they were removed, a masonry wall was built up to the level of the quay. At the back of this wall there were other artificial blocks, from the upper side of which a further embankment of stones was formed, having an inclination of 1 to 2. The quays of the Arene and Napoléon docks were 2·4 metres, and those of the Lazaret dock 3·4 metres, above the water line. In several places, the embankment beneath the artificial blocks had moved, generally slipping forward, and causing the artificial blocks, as well as the quay walls resting on them, to incline over towards the dock. This usually arose from an insufficient time having been allowed for consolidation, and most frequently occurred in the quays or the moles, where it had caused some of the walls to yield. Owing to the instability of the quay walls, and from the nature of the embankment behind them, the quay cranes simply rested on platforms of heavy timbers, which had sufficient base to insure stability during the "slewing" of the jibs. The entire length of the quays at present constructed, belonging to the Dock Company, was 2840 metres. The cost of the quays above the embankment, that was of the quay walls with the artificial blocks supporting them, was £24 per lineal metre.

Sheds, 14 and 10 metres in width, extended completely round the Dock du Lazaret. These sheds were covered with a simple roofing of double T iron, the rafters for supporting the tiles being also of iron, of an A section. The side towards the dock was closed by sliding or rolling doors of corrugated zinc, the roof resting on this side on cast-iron hollow columns, and on the other on the walls of the magazines. These magazines were of one story only at present, and were constructed of rubble masonry, with dressed piers and quoins, and wrought-iron roofing, with vaults in brickwork. The amount of covered space, including the floors, was 67,132 square metres. The flooring for all the magazines and sheds was composed of a layer of asphalte, half an inch in thickness, costing two francs per square metre; but, including the levelling of the ground, and the bed of cement below, the cost was about 6 francs per square metre.

The bonded warehouses, or *entrepot commercial*, formed one block of buildings, to which were attached the Company's offices. Two lines of railway, and a public thoroughfare which ran parallel to it, separated these buildings from the Dock du Lazaret. On the east side were sidings from the Paris, Lyons and Mediterranean Railway, a junction with this line having been made by means of an incline and

a tunnel under the town. The length of these warehouses was 365 metres (1200 feet), with a breadth of 37·5 metres, and a height of 35·7 metres. The offices were of the same breadth, with a length of 37·6 metres. The warehouses were divided into four quarters, each containing an interior court, with two doorways. There were six stories above the ground floor, with vaults below; the whole having been constructed in stone and iron,—the concession requiring that all the materials should be fire-proof. The masonry was for the most part a better class of irregular rubble; but the piers, arches, quoins, windows, and ornamental work, were of dressed ashlar. The cost of the several kinds of masonry and brickwork per cubic metre was—hard limestone, dressed and built in place, £4; less hard quality, £3. 4*s.*; soft calcareous stone, from Miramas, £2. 2*s.*; rubble, 12*s.* 6*d.*; and brickwork, whether of solid or of hollow bricks, £2. 8*s.* The thickness of the walls was 1·25 metre at the foundations, 1·08 metre at the ground floor, and diminished gradually to 0·58 metre at the sixth story. The ground floor was supported by massive stone pillars and vaulting, while the other floors rested on cast-iron columns. Each quarter was provided with two hydraulic hoists, capable of lifting 1½ ton each, and with two sets of lowering apparatus, the cradle going up empty, by means of a counter-weight, while the extra charge brought it down again. All these warehouses were constructed without the aid of scaffolding, by means of three travelling cranes, two on one side, and one on the other, of the buildings. These cranes consisted simply of a jib 28 metres in length, suspended a little below its centre; the extreme load lifted at one time was 2½ tons, and per day, by each crane, 150 tons. There were 14,136 cubic metres of masonry in these warehouses, and it had cost 3,000,000 francs (£120,000), exclusive of the foundations, the latter having cost 203,000 francs. All the doors and window frames were of wrought iron, £30 per ton having been paid for the former, or in all, for the doors alone, £4800.

The floors for each storey were composed of wrought-iron double T girders, ½ a metre in depth, 4·53 metres in length, and weighing 145 kilos per metre. These rested on cast-iron hollow columns, varying in section at each storey, according to the load. The junction of two columns with the wrought-iron girders was made in such a way as to allow of the expansion of the girders taking place. One column simply rested on the top of the other, the two ends being turned in a lathe, while the girders rested on the lower flange of the upper column, the attachment being by bolts. The columns were all cast vertical, were 4 metres in height, and were tested to support a vertical load equal to 8 kilos per millimetre of section. The wrought-iron girders were subjected to a tensional force equal to 12 kilos per millimetre of section. The cost per ton of the girders had been £22, of the tie rods and other pieces of wrought iron, 500 francs, of the columns and pedestals 300 francs, and of ordinary castings 270 francs. The vaulting between the girders was built of hollow bricks, 6 inches deep, costing 10 francs per square metre complete. The floors were all constructed to carry 2 tons per square metre, but it was believed that they would bear much more with safety.

The wrought-iron roofing of the warehouses was then described in

detail. The girders were composed of two angle irons at the top, and two at the bottom of the section, separated by strips of flat iron, forming a sort of lattice web. The girders were free to move in the direction of their length, resting simply on a cast-iron shoe embedded in the wall. They were 4 metres apart from centre to centre, and were separated at the crown by similar girders. The tiles were supported by iron of an **Λ** section, 8 centimetres in depth, and galvanized. It was calculated that this roof would sustain 4 cwt. per square metre. The vaulting between the girders was of hollow bricks, similar to those used for the floors, but much lighter. The vaulting cost, including all expenses, 6*s*. 8*d*. per square metre. The quantity of cast and wrought iron was 340 tons, and its mean cost had been £24 per ton.

The total cost of these bonded warehouses, comprising machinery, hydraulic pipes, &c., had been half a million of pounds sterling.

The author then proceeded to allude to the graving dock accommodation at Marseilles, which was at present almost entirely of a provisional character; a canal of communication between the old and new ports having been temporarily converted into two docks for this purpose, at a cost of £31,200. The number of ships annually docked in these two docks was 160.

There was likewise a floating dry dock, built of wood about eighteen years back. It was simply a box, 64 metres in length by 19 metres in breadth and 7 metres in depth, and cost, with engines, &c., complete, 355,000 francs. No rot whatever had as yet appeared in the timber, nor had the worm attacked it.

New graving docks were in course of construction at the northernmost extremity of the docks, leading out of the Dock Impériale. These would comprise two basins, with a hydraulic lift, on Mr. Edwin Clark's system, and a suitable shallow basin for the pontoons forming part of this system.

In conclusion, the author gave the results of some experiments made by M. Barrett, the engineer-in-chief, on the hydraulic machinery, with a view of ascertaining—first, the volume of water actually given out by the hydraulic pumps as compared with the interior volumes of these pumps, or the working capacity at different speeds of engine; and, secondly, the useful mechanical effect of the hydraulic apparatus as compared with the steam engine and accumulator. It should be stated that the character of this machinery was precisely similar to that which had been so largely applied by Sir William Armstrong in England, and that all the designs were furnished by him, the execution of the work having been entrusted to the "Société des Forges et Chantiers." The particulars of the experiments were recorded in great detail; from which it would appear that the weight lifted by the hydraulic hoists was only about 45 per cent. of the power contained in the water, and 30 per cent of the indicated horse-power on the steam piston. This would seem to be a small result; yet, where many machines were used, there was no doubt of the great advantage of this system—only one steam engine being employed, and this collecting its force, by means of accumulators, for a moment, when many machines might be working simultaneously. The results of experiments with a three-cylinder direct-acting rotary engine of 8-horse power were much greater,

the useful mechanical effect being 65 per cent. of the water used, or 20 per cent. more than in the case of the hoists.

Although, up to the present time, the docks had not been successful in a commercial point of view, yet it was believed they could not fail ultimately to reap great profits, as well from the superior accommodation they afforded, as from the fact of the fast increasing commerce of Marseilles, the imports and exports to which might now be estimated at 3,000,000 tons per annum.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

February 7th, 1865.

R. ANGUS SMITH, PH.D., F.R.S., &c., PRESIDENT, IN THE CHAIR.

THE President drew attention to the late fatal explosion at Peterborough, and asked whether the easy method of testing steam boilers, described some years ago by Dr. Joule, was forgotten, or found to be impracticable?

Dr. Joule said, that he had taken pains to give his method—by which the testing by hydraulic pressure could be applied with the utmost facility, by simply filling the boiler with water, and then raising its temperature a few degrees—a very extended publication. He believed that the objection raised by some to its use, was the absurd one that hydraulic pressure injured the boiler. The very object of a test was to detect weak boilers, for the purpose of strengthening or rejecting them. He was at a loss for terms strong enough to express his opinion of the reckless disregard of life, or the ignorance which resulted in the deplorable catastrophes which were constantly occurring; and he believed that the only method of cure would be that proposed by Mr. Binney, in the case of the explosion of firedamp in mines, namely, that the parties to blame should be compelled to support the widows and orphans of their victims.

Mr. Alderman Pochin stated that he had made use of Dr. Joule's plan, and found it quite practicable and easy of application.

A paper was read "*On a new re-agent for the separation of calcium from magnesium*," by EDWARD SONSTADT, Esq.

WHEN, in the ordinary course of qualitative analysis, carbonate of ammonium is used to separate calcium from magnesium, unless the former is present in notable proportion to the latter, a very insoluble double carbonate of magnesium and ammonium always accompanies the carbonate of calcium, if this is allowed sufficient time to form. If much magnesium and *no* calcium is present, the magnesium precipitate still falls after a while. Both metals are precipitated by this re-agent, the only difference being that the calcium precipitate forms somewhat earlier than the magnesium precipitate. This fact is

cursorily mentioned by Fresenius, more fully by Gmelin, and has recently been made the subject of special notice by Dr. Dyer. Calcium, therefore, can only be separated from magnesium, by this re-agent, by fractional precipitation, which necessarily involves loss of substance; and, in qualitative examination, the method is sure to mislead when the proportion of calcium present is small, unless it is controlled by other methods. The same remarks apply in substance to the two other methods of precipitation by sulphuric acid and alcohol, and by oxalate of ammonium. When a moderately strong solution of Epsom salts is treated with sulphuric acid and alcohol, the solution is mostly converted into a crystalline magma; and if it is desired to separate a small proportion of calcium, which we will suppose to be present, the magma must be filtered, dissolved, and subjected to the treatment again and again, to separate the sulphate of calcium, when, if the quantity of that salt present be very minute, it must be wholly lost. Of course these remarks do not apply to solutions of calcium and magnesium salts containing much of the former, except in a modified degree. What is true of the sulphuric acid and alcohol process, is true in a more extended sense of the oxalate of ammonium process. I have precipitated, within a trace, the whole of the magnesium present in a considerable quantity of solution of chloride of magnesium, simply by successive additions of oxalate of ammonium,—the solution being concentrated to its original bulk after the last addition of the re-agent. Yet, in working with this re-agent, the rule is, that enough of it must always be added to transform all the magnesium salt into oxalate, since oxalate of calcium is soluble in solution of chloride of magnesium. That some magnesium salt must precipitate with the lime salt under such conditions is obvious; and that it does so is well known, and is, though incompletely, provided for by the process being directed to be repeated upon the precipitate first obtained. This process, therefore, is also one of fractional precipitation, and for it to approach success, the operator must know pretty nearly beforehand how much calcium, in proportion to the magnesium present, he has to deal with. Nevertheless, it is unquestionable, that in skilled hands, either of the two last processes is capable of giving close approximations to the truth, when the quantity of calcium present amounts to a few per cent. of the mixed salts. When the quantity of calcium is less than one per cent., I do not think it is possible to estimate it accurately by any of these processes; and when the proportion is larger, the processes are at least more troublesome, have a wider limit of experimental error, and are more apt to fail in less experienced hands, than the analytical processes in use for estimating most of the other commonly occurring elements.

In common tungstate of sodium we possess a test for calcium, which is probably equal in delicacy and in certainty to that of chlorine for silver, or of sulphuric acid for barium.

The action of this test, in a preliminary examination, requires to be ascertained—

(1.) With calcium solutions alone.

(2.) The presence of magnesium.

(3.) The presence of magnesium and ammonium salts, and of these with free ammonia.

(1.) *The behaviour of tungstate of sodium with solutions of calcium salts.* A saturated solution of sulphate of calcium, taken at 13° C, remains perfectly clear on addition of an equal volume of a saturated solution of tungstate of soda for a short time. On warming, when the solution attains the temperature of 42° C, it becomes turpid, deposits a film upon the containing glass vessel, and soon after a dense precipitate falls. To ascertain the limit of the action of the test, the solution of sulphate of calcium was successively diluted to various degrees, and precipitates obtained, until the solution was so dilute that it contained but one part of sulphate of calcium in 114,000 parts of water. A few drops of solution of tungstate of sodium were added, the solution warmed, and at 56° C, the solution became distinctly opalescent. An experiment was then made on the distilled water used for the dilution, but it gave no reaction. It was evident that it was possible to push the attenuation much further, and yet get indications of calcium. But this proportion ($\frac{1}{114000}$) is near the limit at which sulphate of calcium may be rendered *distinctly* visible. A solution of chloride of calcium behaves similarly. Sulphate of magnesium is not precipitated by tungstate of sodium, unless the solutions of the two salts are strong. The experiments were made with a solution of pure sulphate of magnesium, of specific gravity 1·114, and containing 11·283 per cent. of the anhydrous salt. The solution of tungstate of sodium was saturated (at common temperature), and contained about one-third its weight of dry salt. A mixture of equal parts of these solutions gave no precipitate in the cold, but quickly crystallized when warmed, the crystals being difficultly soluble, and leaving a very slight residue of an insoluble variety of tungstic acid, or of some compound of that acid. But when the mixed solutions above described were very little diluted, the solution remained perfectly clear at any temperature, until the fluid was concentrated by evaporation, when no precipitate, but clear crystals, appeared. It is only, therefore, in very concentrated solutions that tungstate of sodium gives—not then a precipitate—but crystals, with sulphate of magnesium. The chloride of magnesium solution behaves similarly, though it was not so closely examined.

(2.) *The behaviour of tungstate of sodium with solutions containing calcium and magnesium.* The earlier experiments seemed to indicate that the presence of magnesium did not at all interfere with the precipitation of the calcium; but on continually diminishing the quantity of the calcium salt, while that of the magnesium salt was kept constant, it was found that the latter exercised a very appreciable solvent power. The limiting experiment was as follows:—To 5 cc. of a solution containing 7 parts in 100,000 of sulphate of calcium, were added 3 cc. solution of sulphate of magnesium, containing 11·283 per cent. anhydrous salt, 12 cc. water, and a few drops of tungstate of sodium. There were thus, in 2,000,000 parts of fluid, 35 parts sulphate of calcium, and 33,849 parts sulphate of magnesium—the remainder being water, except the small quantity of tungstate of sodium. The reaction was not visible till the fluid reached the temperature of 70° C, when it became apparent, and, on putting it aside to cool, a perfectly distinct film formed on the glass. A similarly attenuated solution of the lime salt, but containing no magnesium, was exposed to the same conditions with the re-agent, and the reaction in the latter case

occurred earlier, at a lower temperature, and was more distinct. Nevertheless, the fact remains that, in a mixed solution of the sulphates of calcium and magnesium, the presence of the former may be clearly detected, up to the proportion of about 1 part in 56,000 of fluid, containing about 1000 parts of magnesium salt. Rougher experiments made with the corresponding chlorides led to similar results.

(3.) The influence of ammonium salts in obstructing the precipitation of calcium in presence of magnesium is very marked. A calcium salt, in presence of a very large proportion of both magnesium and ammonium salts, cannot be certainly recognised, except somewhere near $\frac{1}{4000}$th of the calcium salt be present in solution. The influence of free ammonia with sulphate of ammonium and sulphate of magnesium, in like large proportions, is so great as to only just admit of the recognition of the calcium when from $\frac{1}{500}$th to $\frac{1}{1000}$th is present. Nevertheless, enough, and rather more than enough, ammoniacal salt may be present to prevent any precipitation of magnesium by excess of ammonia, and a moderate excess of ammonia may also be present, without sensibly affecting the estimation of the lime in a quantitative experiment. Chloride of ammonium does not dissolve the precipitate when it is once formed.

The analytical experiments on weighed mixtures of calcium and magnesium salts, imperatively necessary in introducing a new re-agent, are not yet completed, most of the experiments of this kind made till now having been vitiated, through ignorance of the conditions necessary to insure success. I give, however, the results of one experiment, the conditions of which approached more nearly to those I now know of as being necessary than the others, reserving the series, together with the methods adopted for obtaining pure materials to work with, for a second paper.

	Taken.	Found.
Magnesia	0·3097 grms.	0·3120
Carbonate of calcium	0·0043	0·0042

The weighted quantities of carbonate of calcium and of magnesium were dissolved in a slight excess of hydrochloric acid; neutralised carefully by ammonia, precipitated by tunsgtate of sodium, and then the filtrate, with the usual precautions, by common phosphate of sodium. The excess in the weight of pyro-phosphate of magnesium led to the suspicion that some tungstic acid had been carried down—a suspicion amply confirmed by the coloration obtained from the solution of the ignited precipitate in dilute hydrochloric acid when treated with tin.

A little in anticipation of my intended future paper upon the subject, I now add such details respecting the manipulation required in separating lime from magnesia by tunsgtate of sodium as my experience has shown to be necessary. It is convenient to have the solution of the magnesium and calcium salts made somewhat alkaline by ammonia, but a very large quantity of this, as well as of ammoniacal salt, is, as we have seen, to be avoided. The beaker in which the precipitation is to be effected should, while perfectly dry and warm, be rubbed within by chamois leather, on which a drop or two of fine oil (such as is used for oiling balances) has been put. If this precaution be not taken, it will be found impossible to detach the precipitate of tungstate of calcium from the sides and bottom of the vessel. A considerable excess

of the re-agent is not necessary; but if it occur, is not material. If, on addition of the re-agent, a white, floculent precipitate forms immediately, it is well to add a few drops of ammonia, when the floculent precipitate will re-dissolve; but if it does not re-dissolve after warming there is some other element present, which, if ordinary Epsom salts are used, will probably be manganese. The tungstate of calcium precipitate is very dense; it forms slowly in very dilute solutions, and, in all cases, several hours should be allowed for it to form. The solution should be warmed meanwhile, but should not be allowed to boil. The precipitate must be washed, till the filtrate shows no cloudiness on standing, with the nitrate of silver, when the salts are chlorides; or, if they are sulphates, till the chloride of barium gives no cloudiness. The precipitate must then be further washed with dilute solution of ammonia, but these washings need not be saved. The filter should be burnt separately, after the precipitate is cleared from it as nearly as possible. After the ignited precipitate is weighed, a little strong solution of ammonia should be poured upon it, and allowed to stand for awhile, when the ammonia is decanted and supersaturated with acid. If a precipitate falls after a time, the tungstate of calcium precipitate should (without being removed from the crucible) be allowed to stand for some hours with more ammonia: it is then washed by decantation, again ignited, and weighed. The ignited precipitate should be perfectly white.

The filtrate, containing the magnesium salt and tungstate of sodium, may be at once precipitated by phosphate of sodium in the usual way: but if this is done, much washing is required to get rid of the little tungstic acid that adheres obstinately to the precipitate. It is better, especially when a great excess of the re-agent has been used, to first precipitate the tungstic acid by a considerable excess of hydrochloric acid, and boil until the precipitate becomes dense and intensely yellow. The solution is then filtered, supersaturated with ammonia, and the magnesia precipitated in the usual way; but, even in this case, it is better to wash lastly with stronger ammonia solution than ordinary.

REPORT OF THE COMMISSIONERS APPOINTED TO INQUIRE INTO THE WORKING OF THE PATENT LAWS.

The following is the Report (slightly abridged) of nine out of the ten Commissioners appointed to consider this important subject. Mr. Hindmarch, the remaining Commissioner, dissented from this Report, and Mr. Fairbairn also dissented in one important particular:—

"To the Queen's Most Excellent Majesty.

"May it please your Majesty,—We, the Commissioners appointed to inquire into the working of the law relating to patents for inventions, humbly present to your Majesty the results of our investigation in this our Report.

"Our attention was at the outset directed to the consideration of those defects in the working of the present system which, since the

amendment of the law in the year 1852, had become so generally felt as to have given occasion for the institution of the present inquiry.

"Of these the most important appear to be the protracted litigation and consequent expense which, in almost every case, result from the present mode of trying questions of patent rights. Two instances were stated to us in evidence in which the law expenses of plaintiff and defendant together amounted to £26,000 and to £15,000 respectively. The course of litigation began in the former case in 1857, and may at the present moment be still further protracted; in the latter it lasted from the year 1842 until 1855. It may be added, that since the Commission met, a single case has occupied the attention of the Court of one of the Vice-Chancellors for upwards of thirty days.

"The multiplicity of patents arising from the facility and diminished cost of obtaining them has been brought to our notice as another serious cause of complaint against the present law. It appears from the tables compiled at the Great Seal Patent Office, that the average number of provisional protections annually granted is now about 3000, while the patents sealed exceed 2000, and that an increase on this average may be expected. The evil arising from this multiplicity of monopolies is alleged to be of a twofold nature,—in the first place, that of the existence of a number of patents for alleged inventions of a trivial character; in the second place, that of the granting of patents for inventions which are either old or practically useless, and are employed by the patentees only to embarrass rival manufacturers. Thus, in either case, that monopoly, one of the main grounds of defence of which is the stimulus it offers to invention, obstructs, instead of aiding, the progress and improvement of arts and manufactures.

"On the other hand, we have been pressed with the opinion that the cost of obtaining letters patent, together with the fees payable on their continuance up to the full term of fourteen years, although reduced to £175, payable by instalments, of which the first does not exceed £25, is still so high as to be an insuperable bar to the poor inventor in obtaining the protection to which he is fairly entitled.

"Again, it is claimed by inventors, on the ground of public policy, that the tax imposed on the granting of patents, and thereby indirectly on inventors, should be no more than sufficient to cover the expenses of the Great Seal Patent Office, and of the necessary libraries and museums connected with it. At the present date it appears that the accumulation of surplus fees (after allowing for all such expenses) since the year 1852, amounts to more than £200,000, and that for future years the annual surplus upon the present footing may be estimated at £40,000.

"With such considerations before us, and knowing that, from the nature of the subject, the remedies suggested would vary within very wide limits, we determined, as the basis of our inquiry, to draw up a series of questions which should invite suggestions upon those points of the present system where amendment seemed to be required.

"We have thought it most convenient, in considering the evidence before us, to arrange it under the following heads:—

"I. A statement of the successive stages of procedure in applying for the grant of letters patent, of the fees payable at each stage and during the continuance of the term of fourteen years, and of the

procedure on disclaimers, memoranda of alterations, confirmations, and prolongations.

"II. Opinions on the question whether it is or is not expedient that patents should be easily and cheaply granted.

"III. Objections to the present mode of trying cases of patent rights, and alterations which may be suggested.

"IV. The various opinions on the working of the system as regards disclaimers, memoranda of alterations, confirmations, and prolongations, and on the propriety of granting patents to importers of foreign inventions, and to foreign inventors.

"The evidence on these latter branches of our inquiry, as well oral as written, may be classified under three general heads:—1, that of judges and members of the legal profession more especially acquainted with this branch of the law, and of the gentlemen officially engaged in the working of the present system; 2, that of patent agents; 3, that of engineers and manufacturers, many of whom represent in their own persons the conflicting interests of the inventor and of the user of inventions.

"I.

"The first step on the application for letters patent is to lodge at the Great Seal Patent Office the petition, which discloses only the title of the invention, the provisional specification, "describing the nature of the invention," and a solemn declaration by the applicant that he believes himself to be the true and first inventor. These documents are referred to one or other of the law officers of the Crown, whose duty goes no further than to decide whether or not the nature of the invention is sufficiently described by the provisional specification. By section 8 of the Patent Law Amendment Act, 1852, the law officer is at liberty to call, in aid of his decision, mechanical or scientific assistance, and to order the payment of such fees as he may think fit to the persons so called in. This power is, however, only occasionally exercised. The law officer, upon being satisfied of the sufficiency of the provisional specification, grants his certificate, allowing provisional protection. The granting of the certificate is then advertised in the *London Gazette* and in the *Journal of the Commissioners of Patents*.

"This investigation before the law officer may, however, be avoided by lodging in the first instance a complete specification, 'particularly describing the nature of the invention, and in what manner the same is to be performed.' In this case the certificate issues as of course.

"Within four months from the date of his application, notice must be given by the applicant of his intention to proceed with his patent. Advertisements of this intention, stating nothing more than the title of the patent, are then officially issued, and a period of twenty-one days is allowed, within which objections to the grant may be lodged at the Great Seal Patent Office. The case between the applicant and the objector is then heard by the law officer, the parties usually appearing separately, the provisional specification being in practice regarded as a secret document. When, however, from the mode of conducting the opposition, the law officer finds that the nature of the new invention has become known to the opponent, he sometimes uses his discretionary power of hearing the parties in the presence of one another.

"Cases have sometimes occurred in which the law officer has refused his fiat, on the general ground of want of novelty. This, however, has only been where it was brought to his knowledge that the invention claimed was clearly not new; for, from the fact that no appeal lies from his refusal of the fiat, the inclination has always been to grant the application where a fair doubt exists.

"The applicant, if successful upon this hearing, obtains from the law officer his fiat for the warrant; but the objector has still a right (by entering a caveat at the Great Seal Patent Office) to appeal to the Lord Chancellor against the issue of the fiat.

"The next stage is the application for sealing the letters patent, which must be made within three months from the date of the warrant. Here there is again an opportunity of opposing the grant. Notice of objection must be lodged as at the former stage, and the parties are then heard before the Lord Chancellor, who has the power (occasionally, though not often, exercised) of referring the matter to the law officer for his opinion. The decision of the Lord Chancellor is, in any case, final, the patent, if successful, being sealed, and dated as of the date of application.

"In accordance with the rule that the provisional protection lasts for six months only from the date of application, or for such further time as the Lord Chancellor may, upon petition of the applicant, in his discretion allow, the complete specification must be filed within that period, or within such further time as may have been allowed. If this be not done, the protection ceases, and the grant, if made, becomes void.

"In order to maintain the validity of the grant, the patentee must, before the end of three years from the date, pay an additional sum of £50; and, before the end of seven years, the further sum of £100—thus making the whole cost in fees £175. About two-thirds of the patents granted become void at the expiration of the third year for non-payment of the fee of £50, and less than one-tenth are continued beyond the seventh year.

The mode of obtaining the repeal of letters patent is by writ of *scire facias*. Since the alteration of the practice in 1852, by which the patentee was allowed the right of replying, this mode of proceeding—at no time common—has fallen into disuse.

"The patentee may, at any time during the continuance of his grant, by petition to the Commissioners of Patents, apply for leave to disclaim a part of the title or of the specification of his patent, or to alter either of them, but so that neither disclaimer nor alteration shall extend the exclusive right. The matter is then referred to the law officer, and on his fiat the disclaimer or memorandum of alteration is filed at the Great Seal Patent Office, with the specification.

"In cases where, subsequently to the taking out of a patent, it is discovered by the patentee that some part of the invention for which such patent is claimed already exists in a printed form, but, having long escaped public notice, has become obsolete, and where a re-discovery by the patentee has taken place, application may be made to the Judicial Committee for confirmation of the patent, notwithstanding want of novelty in the invention for which it is claimed.

"The same mode of proceeding is followed for the purpose of obtaining prolongation of the full term of fourteen years, the Judicial

Committee having power to recommend to your Majesty the extension of the original term for a further period of fourteen years. The usual length of time of extensions, however, is not more than from three to six years. Advertisements of application for prolongation are inserted in certain local and metropolitan newspapers, and objections are taken by entering a caveat. The objector must lodge his grounds for opposition in writing, and may appear at the hearing of the application in support of them. In all cases the law officer attends at this hearing to watch the case on the part of the public, and has a right to take part in opposition to the extension.

"Three general rules may be laid down by which the Judicial Committee have been guided in recommending prolongations. The patentee must show:— first, that the invention is of great ingenuity and merit; secondly, that it is of considerable public utility; thirdly, that, in spite of his reasonable exertions to promote the invention, the remuneration he has received from it is inadequate.

"II.

"On the question whether patents should be made easy or difficult to obtain, we find a division of opinion—some witnesses denying, others affirming, the existence of public inconvenience from an indefinite multiplication of these temporary monopolies.

"In the opinion of the former class, such inconvenience either does not exist at all, or—if it is in any slight degree felt—is so exceptional as to require no especial legislation. They maintain that, as a rule, patents which are either frivolous in their character or questionable on the ground of want of novelty, are not supported by the patentee when exposed to the test of payment for renewal or of the expense of litigation. They contend that, without the protection given by a patent, many inventions useful in character, though not of primary importance, would either not be made, or, being made, would remain undivulged; that to decide beforehand with certainty on the value or worthlessness of an invention is seldom possible; and that the evil remedies itself, inasmuch as worthless patents are seldom continued beyond the period of three years.

"The majority of witnesses, however, decidedly affirm the existence of practical inconvenience from the multiplicity of patents. It is clear that patents are granted for matters which can hardly be considered as coming within the definition in the Statute of Monopolies, of 'a new manufacture.' It is in evidence that the existence of these monopolies embarrasses the trade of a considerable class of persons—artisans, small tradesmen, and others—who cannot afford to face the expense of litigation, however weak the case against them may seem to be; and a still stronger case is made out as to the existence of what may be called obstructive patents, and as to the inconvenience caused thereby to manufacturers directly, and through them to the public.

"From a paper drawn up, at our request, by the Superintendent of Specifications, it appears that, upon examining into the first 100 applications for patents in each of the years 1855, 1858, and 1862, the results were, in his opinion, that in 1855, 26 were manifestly bad for want of novelty, and 6 more partly so; in 1858, 14 manifestly old, and 1 partly so; in 1862, 7 were old, and 1 would probably turn

out to be so. An instance, illustrating the mode in which these patents are used, is given in evidence, where royalties had been demanded, and in most cases obtained, by the patentee of a machine, which turned out upon investigation to be identical with one which nineteen years before had been well known and publicly used.

"Other instances will be found in the evidence of particular manufactures and branches of invention which are so blocked up by patents that not only are inventors deterred from taking them up with a view to improvement, but the manufacturer, in carrying on his regular course of trade, is hampered by owners of worthless patents, whom it is generally more convenient to buy off than to resist. The evil also results in another practice, having the same obstructive tendency—namely, that of combination among a number of persons of the same trade to buy up all the patents relating to it, and to pay the expense of attacking subsequent improvers out of a common fund. From a comparison of evidence it cannot be doubted that this practice prevails to a considerable extent. We must also conclude that when the obstruction is not to be got rid of without the expense and annoyance of litigation, in a larger majority of cases the manufacturer submits to an exaction rather than incur the alternative.

"We desire to call especial attention to the evidence given by the First Lord of the Admiralty, and by various witnesses on behalf of the War Department, showing the embarrassment which has been caused to the naval and military services by the multitude of patents taken out for inventions in use in those departments. It appears to us necessary for the public service that, for the future, no patent should be granted without the insertion of a proviso, allowing to the Crown the unrestricted use of the invention therein patented, the compensation for such use to be fixed by the Treasury.

"Having in view the several opinions thus shortly adverted to, we have to consider the evidence:—

"1. As to the cost of obtaining and renewing letters patent, and as to the mode of payment.

"Notwithstanding the prevalence of an opinion that patents may be and are unduly multiplied, a very small minority is in favour of increasing the cost of obtaining them. Of those who have given evidence in this sense, some object altogether to the granting of patent rights, and, therefore, consistently desire that, if not abolished, they should be reduced in number by any practicable method. Others contend that the mere fact of having a larger payment to make would render projectors more careful not to incur expense on behalf of inventions of doubtful utility and novelty. Many witnesses think that the scale of payment was, on the revision of the law in 1852, fixed too low, but do not consider that it could now be prudently raised.

"Objection is taken by a third class of witnesses to the payments of £50 and £100 on the renewal of the patent at the end of the third and seventh years respectively. It is alleged that the periods of payment are fixed too early for the duration of the monopoly; that many valuable patents have, even in their seventh year, failed to become profitable from the difficulty of inducing manufacturers to adopt new methods of working, and that in such cases the patentee is either unable to procure the necessary sum or is unwilling to risk the addi-

tional expense, and therefore allows his patent to drop; that thus the system inflicts a hardship on the inventor, and retards the general progress of improvement. Several modifications of the law are proposed; one alternative being to reduce these payments, another to postpone them till the end of the fifth and ninth years respectively. It is also suggested that some inconvenience arises from the fact that on non-payment of the renewal fees the patent becomes at once void, and that much of the hardship complained of would be obviated if the Lord Chancellor were empowered to allow the continuance of the patent, on payment being made, though after the proper time, provided the patentee were able to prove that the delay had arisen from accident or from a mistake not involving gross negligence.

"Among the engineering and manufacturing class there seems to be some inclination to urge the adoption of a system of annual payments, on the ground that the burden would thus be more equally distributed over the whole period of the patent, and that the rich and the poor inventor would thereby be brought upon more equal terms, while there would be a constant tendency on the part of patentees to allow an unremunerative patent to drop at once.

"The propriety of a system of annual payments is, however, denied by the greater number of those who have given evidence before us, who rely on their experience of the difficulty that is now constantly found in getting patentees to insure the renewal of their patents by the necessary formalities; they maintain that this difficulty would be the source of still greater evil if the same process had to be gone through from year to year.

"Whatever be the scale of payment adopted, we find a very general expression of opinion that the price to be paid by inventors in the aggregate should not be more than sufficient to provide for the expenses of the Patent Office, library, and museum; and that these should be maintained in the highest state of efficiency, so as to give inventors the utmost facility for ascertaining the status of every branch of invention.

"2. As to the introduction of a system of preliminary examination, its character, and by whom it should be conducted.

"It is urged, in opposition to any further course of preliminary examination than that which is at present pursued—first, that the principle of our law requires the inventor himself to make such an examination, inasmuch as he takes out a patent at his own risk, and next, that it could not be conducted in a manner free from objection. That if it were *ex parte*, the interests of the public would be no better protected than they now are; if subject to opposition, the inventor would be deprived of the protection of secrecy, while he would, in fact, be subjected to a premature trial of his patent, and that such a trial, even if it resulted in his success, would be no protection to him against future litigation.

"That if the result of such an examination was to be final, the examining body would seldom undertake the responsibility of refusing a patent; if subject to appeal they would, on the hearing of that appeal, be placed in the position of defendants. That on the whole the result would be increased expense and delay to the patentee, with no greater security either to him or to the public. These opinions,

though proceeding from a limited number of witnesses, deserve consideration from the knowledge and experience of those by whom they are entertained.

"On the other hand there is a very strong expression of opinion, and one not confined to any particular class of persons, in favour of some more strict preliminary examination. It is suggested by a few of these, but only by a few, that such an examination ought to embrace an inquiry not only into the novelty, but into the utility of the invention. It is admitted that the inquiry as to novelty must be limited to matter which is to be found in a printed form, and should not extend to oral testimony as to priority of user.

"It is proposed that such an examination be conducted by the members of a mixed Board of Examiners, consisting of one or more barristers, and a proportionate number of practical and scientific men; and that this Board should, unless forming part of, or acting in concert with, some special tribunal to be appointed for the trial of patent cases, be assistant and subordinate to the law officers of the Crown, whose official duties in respect of patents should otherwise remain unaltered. That the result of this examination should be either a decision subject to one final appeal, or a certificate which, whether favourable or unfavourable, should be appended to the specification.

"The general opinion seems to be that the interest of the public would be sufficiently protected at the hands of the examiners, and that, at any rate, the result would be to exclude many applications which now, of necessity, pass without comment.

"With respect to caveats, it is held by a majority of witnesses that the present system should remain unaltered, subject to such modifications in practice as might be required by the institution of preliminary investigation.

"3. As to the propriety of making licences compulsory, or of requiring user within a given period.

"As against these propositions it is contended by some witnesses that patentees are, as a rule, willing to grant licences to work their inventions on reasonable terms. To do so is obviously their interest; and it may be assumed that what is men's interest to do will generally be done. Exceptions may occur, but these, it is asserted, will be insufficient in number and importance to justify a peculiarly sweeping interference with rights to which the law has assigned the character of property.

"Apart from the above considerations, the practical difficulties appear to be regarded as all but insuperable. No rule can be laid down for estimating the value of a patent, or the amount of charge which may be reasonably imposed on those using it. These will vary in every instance; and it is manifestly futile to require the inventor to grant a licence when applied to, unless some provision be made for determining the price to be paid. In the absence of such provision a prohibitory price would render the law inoperative. But on this question of price, individual opinions must be expected to vary widely; and it is impossible to suppose that any system of arbitration would prove satisfactory where neither precedent, nor custom, nor fixed rule of any kind could be appealed to on either side.

"4. As to the repeal of invalid patents.

"It appears to be generally felt, more especially by those who are immediately concerned in managing the litigation of patent rights, that some proceeding, more simple in form, and therefore more expeditious, should be adopted for the repeal of invalid patents. That this might either be by petition to your Majesty in Council, or by motion in a court of equity. The most serious objection to the present mode of proceeding seems to be, that while a patentee, if he maintains his patent, will only get such costs as may be covered by the bond which is required from the petitioner against him, the petitioner, on the other hand, if he succeeds in his object of upsetting the patent, will get no costs.

"As regards the issues to be tried, it has not been shown to us that any alteration in the form of the proceeding for repeal would materially shorten them or diminish the expenses of the trial.

"III.

"The evidence before us shows an almost universal feeling of dissatisfaction with the present mode of trying questions of patent right, while there are many and various proposals for the constitution of a tribunal which should be more expeditious and less expensive. The principal fault of the system lies in this—that the jury by whom the case is tried seldom possess even so much scientific knowledge as is necessary to enable them to understand the evidence. Advantage is constantly taken of this deficiency,—first, in a subtle and vague drawing of specifications; again, by an artful generality in the form of framing the issues to be tried; lastly, on the trial, by the introduction of a cloud of scientific evidence, to perplex, rather than to explain, the true points at issue. It is possible that these difficulties might, to some extent, be obviated, as has been suggested to us, by requiring a greater strictness in drawing the specification and claim of the patentee, or by a more perfect scheme for settling, in the presence of the judge, the issues to be tried; but it is almost without exception admitted that a radical remedy is only to be found in reforming the constitution of the tribunal itself.

"The main point in doubt is, whether this reform should go to the extent of constituting a special court for the trial of patent cases, or whether the existing jurisdictions of the courts of law and equity should be maintained, in a modified form. The objections to a special court are various and strong. In the first place, the want of sufficient business to occupy its time fully. Secondly, that on trials of patent cases, questions are frequently arising which require an extended knowledge of other branches of the law; and that a judge selected for his special acquaintance with mechanical and scientific topics, and one who in his judicial capacity was principally engaged in the consideration of such questions, would not be so competent to deal with the whole subject matter of the case as one by whom all branches of our law were in turn handled. Thirdly, that such a constitution of the court would render it extremely difficult, if not impossible, to secure an effectual appeal. We do not find that these views (with the exception, perhaps, of the first) have been met by arguments of equal weight. Assuming, therefore, that it would not be advantageous to constitute a

special Patent Court, we have to consider what has been proposed in aid of the existing jurisdictions.

"The general proposal is, that the judge, on trial of a patent case, should either be aided by scientific assessors, or that the case should be tried by a jury composed of from five to seven scientific persons. The latter plan does not appear to us to be wholly satisfactory, owing to the difficulty there would always be in getting a sufficient number of scientific men to compose a jury, sufficiently competent and unbiased.

"The conclusion which we have drawn from the evidence is, that a court might be satisfactorily formed on the former plan, taking as a general model of its constitution your Majesty's High Court of Admiralty, assisted by the Trinity Brethren. It is difficult accurately to estimate the weight of evidence, as to whether those assessors should act judicially, or merely by way of instruction and advice to the judge; but the balance seems rather to incline to the latter view, which would place them in a very similar position with the assessors to the High Court of Admiralty. There is again a great variety of opinion as to the mode in which the assessors should be chosen. It is said, on the one hand, that they might be selected by the judge, or by the parties, with a reference in case of dispute to the judge, from scientific men generally. With respect to this latter proposal, the only doubt is, whether, considering the high value which is put upon scientific evidence, men of sufficient eminence would be induced by any such fee as the court would pay to give up either their usual avocations, or the chance of being employed by one or other of the parties to the suit. On the other hand, if such assessors are to be a permanent and independent body, there will be a like difficulty in providing for payment of sufficient salaries to secure the services of scientific men numerous enough to give the opportunity of selection for the various classes of cases, and eminent enough in their professions to be willingly accepted by the parties.

"It seems to be generally thought that the assistance of an ordinary jury in patent cases is not requisite. There is, however, a certain amount of unwillingness to give up that which is considered by many the safest form of tribunal for weighing of facts and probabilities; it has, therefore, been suggested that the employment of a jury might be at the joint request of the parties, or at the discretion of the judge.

"We have been informed that no difficulty would be found in setting apart a court for the trial of patent cases, and in providing for the attendance in rotation of one of the judges of the courts of law and equity.

"IV.

"1. As to granting letters patent to importers of foreign inventions and to foreigners.

"It has long been the practice, founded on judicial decision, to consider that the use or publication of an invention abroad did not deprive that invention of the character of 'a new manufacture within this realm.' It appears to us, and is generally admitted in the evidence, that the present facilities of communication subsisting between all parts of the world have done away with the only valid reason for such a con-

struction of the words of the Statute of Monopolies. The object of allowing such patents might fairly be, in an age of slow international communication, to encourage enterprising persons to go in search of, and to introduce to this country, useful processes employed abroad, but not otherwise likely to be adopted here, for the want of which we should long have been behind other nations. It does not, however, seem worth while to continue the same facilities now, when foreign inventions are most frequently patented in this country and in their native land simultaneously; especially, as we are well informed, that one result of the practice is to encourage unscrupulous persons to steal the inventions of foreigners, and to run a race with the legitimate owner to get them patented here.

"The general opinion seems to be in favour of granting patents to foreigners, or to their agents or nominees, in this country. By some persons it is proposed to limit the grant to natives of those countries whose Governments allow the reciprocal privilege to your Majesty's subjects; and, further, to impose, as a condition, that the invention be worked or licences granted for working it in this country—following the system which prevails generally on the Continent.

"2. As to confirmations.

"With a single exception, and that merely as a statement of opinion, unsupported by argument, we find no suggestions made to us with a view to the alteration of the present system on this point. We find that only seven applications have been made for confirmation of a patent under the 5th and 6th of William IV., cap. 83, sect. 2, and only one of such applications has been acceded to. We see no reason for retaining a power of which no practical use is made.

"3. As to prolongations.

"We do not find that the witnesses, with one exception, complain of the existence of prolongations; this may, however, be accounted for by their extreme rarity.

"A careful consideration of the evidence given by the Clerk to your Majesty's Privy Council leads us to the opinion that prolongations should not be in future granted.

"The power of granting them is in its nature arbitrary, and it does not seem just that the public should be excluded for a term of years from the use of an invention which, in the ordinary course of law, would otherwise become public, simply because the inventor has reaped from it a smaller profit (possibly through his own want of business habits) than he thought himself entitled to expect. The uncertainty, moreover, whether an application for prolongation will or will not be granted, is an evil to all parties concerned.

"4. As to disclaimers and memoranda of alterations.

"It has been stated to us that the former of these proceedings sometimes results in the enlargement of the patentee's rights, and that more strictness ought, therefore, to be exercised in allowing them.

"With respect to memoranda of alterations, we do not find that any serious objection is taken to a continuance of the present system. It is indeed suggested that, following the French law, patents of addition should be allowed. No reasons, however, are given us in support of this view.

"We have thus stated to your Majesty the general result of the

evidence before us and the conclusions to which we have come after considering it.

"We now humbly submit to your Majesty the following recommendations, which are founded on these conclusions:—

"RECOMMENDATIONS.

"1. Your Commissioners do not find that the present cost of obtaining letters patent is excessive, or the method of payment inconvenient; they do not therefore recommend any alteration of the present system on those points, but they think that patent fees should not be made to contribute to the general expenditure of the State until every reasonable requirement of the Patent Office has been satisfied.

"2. They are unable to recommend a preliminary investigation into the merits of the invention for which a patent is claimed, but they advise that a careful enquiry be instituted, under the direction of the law officers of the Crown, as to whether there has been any previous documentary publication of the invention, either by grant of letters patent or otherwise; and if such publication have taken place, that the patent shall be refused.

"No evidence, other than such documentary evidence, should be admissible, and the reasons for the refusal to grant the patent should be certified by the law officers. An appeal from their decision should lie to the Lord Chancellor.

"3. Your Commissioners are of opinion that the present mode of trying the validity of patents is not conducted in a satisfactory manner. That such trials ought to take place before a judge sitting with the aid of scientific assessors, but without a jury, unless at the desire of both parties to the suit or action. That such assessors ought to be selected by the judge in each case, and the remuneration to be paid them be included in the costs of the suit or action, and provided for in such manner as the judge shall direct.

"That no special judge be appointed for the trial of patent cases, but that the judges of law and equity be empowered to make rules by which one Court should sit for trial of patent cases exclusively. That on such trial the judge, if sitting without a jury, decide questions of fact as well as of law.

"4. That the granting of licences to use patented inventions ought not to be made compulsory.

"5. That patents ought not to be granted to importers of foreign inventions.

"6. That in no case ought the term for which a patent is granted to be extended beyond the original period of fourteen years.

"7. That in all patents hereafter to be granted, a proviso shall be inserted to the effect that the Crown shall have the power to use any invention therein patented without previous licence or consent of the patentee, subject to payment of a sum to be fixed by the Treasury.

"8. While, in the judgment of the Commissioners, the changes above suggested will do something to mitigate the inconveniences now generally complained of by the public as incident to the working of the Patent Law, it is their opinion that these inconveniences cannot be

wholly removed. They are, in their belief, inherent in the nature of a Patent Law, and must be considered as the price which the public consents to pay for the existence of such a law.

"STANLEY.
"OVERSTONE.
"W. ERLE.
"W. P. WOOD.
"H. M. CAIRNS.
"H. WADDINGTON.
"W. R. GROVE.
"W. E. FORSTER.
"W. FAIRBAIRN.

"EDWARD LLOYD, July 29, 1864."

Provisional Protections Granted.

Cases in which a Full Specification has been deposited.

1864.

200. William Edward Newton, of Chancery-lane, impts. in machinery for mowing and reaping,—a communication.—*January 23rd.*

203. Alfred Charles François Deroc-quigny and Dominique Gance, of Paris, impts. in sewing machines.—*January 24th.*

Cases in which a Provisional Specification has been deposited.

2405. James Vine, of Trinity-street, Middlesex, impd. arrangements for giving buoyancy to, and facility for, the propulsion of ships, vessels, or floating bodies.—*September 30th.*

2485. William Gardner, of Lever-street, Saint Luke's, impts. in iron safes for the preservation of property from robbery and fire.—*October 10th.*

2621. Joseph Sourd, of Nelson-square, Blackfriars-road, impd. dredging machine,—a communication.—*October 22nd.*

2659. Norton Nathan Lowenthal Lonsdale, of Nelson-square, Surrey, impts. in appparatus for regulating and controlling the flow or supply of oil or other fluids, whether for lubricating or filtering, or other purposes.—*October 27th.*

2876. Andrew George Hunter, of Rockcliff Hall, Flintshire, impts. in the manufacture of soda and potash.—*November 17th.*

2883. Alexander Angus Croll, of Coleman-street, impts. in the preparation of materials to be used in the purification of gas for illumination.—*November 18th.*

2925. Germain Prioleau, of Montignac des Vezère, apparatus for instantaneously releasing horses from carriages.—*November 23rd.*

2987. Frederick Bernard Dœring, of Bayswater, impt. in levels and other instruments requiring nice adjustment.—*November 30th.*

2994. Fischer Alexander Wilson, of Abingdon-street, Westminster, impd. breech-loading ordnance.—*December 1st.*

3029. William Edward Newton, of Chancery-lane, impd. method of operating guns in fortifications and floating batteries, and in the construction of rotating towers for the same,—a communication.—*December 5th.*

3068. Sidney Truss, of Chester, impts. in the construction of rails for the permanent way of railways and tramways.—*December* 10th.

3079. Albert Baker, of Walpole-street, New Cross, impts. in apparatus for ascertaining the depth of water and speed of ships or vessels.—*December 12th.*

3115. William Bardwell, of Great Queen-street, Westminster, impd.

method of utilizing sewage and urine, and for facilitating their passage through pipes, thereby preventing the pollution of rivers and streams.—*December* 16*th*.

3131. Arthur Auckland Leopold Pedro Cochrane, of Portsmouth, impts. in apparatus for heating and evaporating liquids and fluids.—*December* 17*th*.

3143. Eugene Constant Marie Bonnier, of Paris, atmospherical machine, or the perpetual motion by atmospherical pressure.—*December* 19*th*.

3165. Thomas Woodward, of Birmingham, impts. in breech-loading fire-arms.

3174. William Reid, of Granton, Mid-Lothian, N.B., impts. in the arrangement and construction of wagons or vehicles for the conveyance of cattle upon railways.

The above bear date December 21*st*.

3235. Samuel Saville, of Manchester, impts. in separating wool from refuse mixed fabrics and materials.

3236. Thomas Richards Harding, of Leeds, impts. in apparatus for the manufacture of pins and hackles or gills.

The above bear date December 29*th*.

3251. William Henry Brown, of Sheffield, impts. in the manufacture of cast-steel and other metallic tubes.

3252. Louis Philippe Edouard Max, of Paris, impts. in treating oils and hydro-carbons, and in apparatus for the same; and other operations in which matters have to be purified, clarified, and refrigerated or condensed,—a communication.

The above bear date December 30*th*.

1865.

4. Edward Bevan, of Birkenhead, and Abel Fleming, of Liverpool, impdc jacket or protector for metallis and other vessels and structures, containing solid substances, liquids. or gases, to prevent radiation of heat from, or communication of heat to, such vessels and structures.—*January* 2*nd*.

13. Gustave Mascart, of Paris, impts. in sewing machines.—*January* 3*rd*.

24. Dionisio Vericchio, of Queen-street, Oxford-street, impts. in the construction of spring mattresses and palliasses.—*January* 4*th*.

30. Charles Pickworth, of Homer-road, Hackney Wick, impd. means of communication between the passengers and guard, and between the guard and driver, of a railway train in motion.

32. John William Branford, of March, Cambridgeshire, impts. in washing, squeezing, and mangling machinery.

34. Joseph Skelton, of Lostwithiel, Cornwall, impts. in ploughs.

36. Alfred Vincent Newton, of Chancery-lane, impts. in sewing machines and mechanism for driving the same,—a communication.

38. Gustav Adolph Buchholz, of Alfred-place, Brompton, impts. in apparatus for hulling grain and for reducing granular substances.

The above bear date January 5*th*.

40. Joseph Emile Vigoulétte, of Nelson-square, Commercial-road, Peckham, impts. in the treatment of carbonaceous minerals, and in apparatus for preparing agglomerated fuel.

44. Benjamin Dobson, William Slater, and Robert Halliwell, of Bolton, impts. in machinery for ginning cotton.

46. Arthur Reynolds, of Bagillt, Flintshire, impts. in smelting zinc ores, and in apparatus employed therein.

50. Thomas Richardson, of Newcastle-upon-Tyne, and Martin Diederich Rücker, of Leadenhall-street, impts. in treating guano.

52. Edward Tyer, of Old Jewry-chambers, impts. in apparatus used in train signalling on railways.

The above bear date January 6*th*.

55. George Bell Galloway, of Liverpool, impts. in motive power, and means of communication between passengers while travelling, and appliances connected therewith.

56. Barrowclough Wright Bentley, of Buxton, Derbyshire, and William Henry Bailey, of Salford, impts. in producing and finishing photographs, and photographic transparencies on paper and other suitable substances, and in the machinery employed therein.

57. Edward Beanes, of Priory-road, Kilburn, and Conrad William Fin-

zel, of Bristol, impts. in the construction of vacuum pans.

58. James Atkins, of Birmingham, impts. in the manufacture of metallic bedsteads, which impts. are also applicable to the manufacture of other metallic articles.

60. Joseph Josiah Blackham, of Birmingham, impts. in brooch or other like fastenings.

62. John Franklin Jones, of Rochester, U.S.A., impts. in machinery for the manufacture of paper board.

The above bear date January 7th.

64. John Henry Johnson, of Lincoln's-inn-fields, impts. in machinery of apparatus for cleaning rice, coffee, and other grains or seeds having an outer hull or inner pellicle,—a communication.

66. Lionel Weber, of Brussels, impts. in bits for horses and other animals.

68. William Davies, of Liverpool, impts. in machinery for the manufacture of "cavendish," "negro-head," and other tobacco.

70. Bartholomew Parker Bidder, of Gateshead, impts. in theodolites.

71. Friedrich Wiese, of Vienna, impd. method of preserving from fire books and other articles in safes.

The above bear date January 9th.

72. Edwin Pettitt, of Birmingham impts. in giving permanence to and in ornamenting glass transparent positive photographs.

74. Jonathan Clark Brown, of Brooklyn, New York, impt. in machines for cutting match splints, toothpicks, and similar articles.

78. Adolph Meyer and Moritz Meyer, of Liverpool, impts. in breech-loading fire-arms,—a communication.

79. Thomas Bowerman Belgrave, of Bracebridge, Lincolnshire, impts. in preserving meat.

80. William Clark, of Chancery-lane, impts. in preparing or treating wood and other vegetable fibrous materials for the manufacture of pulp for paper, —a communication.

81. Daniel Gallafent, of Stepney-causeway, and Frederick Pontifex, of Shoe-lane, impts. in artificial fuel.

The above bear date January 10th.

83. Henry Coutanche, of St. Hilliers, Jersey, impts. in reefing and furling sails.

85. William Edward Gedge, of Wellington-street, impd. apparatus for cutting iron gas or other pipes,—a communication.

86. William Edward Gedge, of Wellington-street, impd. pincers for gas and other pipes,—a communication.

87. William Edward Gedge, of Wellington-street, impd. elastic mattress or bedstead,—a communication.

88. Richard Archibald Brooman, of Fleet-street, impts. in engraving upon crystal, glass, and siliceous substances, —a communication.

89. John Ramsbottom, of Crewe, Cheshire, impts. in steam hammers and in apparatus employed in combination with steam hammers.

91. Claude Marie Bathias, of Paris, for improved apparatus for registering the distance travelled by vehicles, or the speed of machinery.

92. John Fry Heather, of Portsmouth, impts. in the construction of keys and locks.

93. Alfred George Lock, of Millbrook, Hants, impts. in extracting and purifying fats and other products from bones and other animal substances, and in apparatus for the same.

94. Abraham Cooper, of Gracechurch-street, impts. in furnace flues for the consumption of smoke.

95. Rock Chidley, of High Holborn, impts. in the construction of railway carriages.

96. James Grafton Jones, of Blaina Iron Works, near Newport, impts. in machinery used for condensing atmospheric air, and in machinery worked by compressed air, employed in getting coal, stone, and minerals.,

The above bear date January 11th.

97. Isaac Goodlad, of Edmund-street, Old St. Pancras-road, impd. apparatus for communication between railway passengers and guards.

98. John Fuller, of Silvertown, Essex, impts. in the coverings of telegraphic conductors and cables.

99. Edward Thomas Hughes, of Chancery-lane, impts. in elastic mattresses and bedding,—a communication.

100. William Russ, of Romford, impd. apparatus for distributing liquid manure.

102. Richard Archibald Brooman, of Fleet-street, impts. in instruments or apparatus for teaching and transposing music,—a communication.
103. Michael Henry, of Fleet-street, impts. in furnaces,—a communication.
104. George Gaze, of Villiers-street, Strand, impts. in tills, and the means of securing and checking money taken by servants.
106. George Henry Daw, of Threadneedle-street, impts. in breech-loading fire-arms.
107. John Burd Hill, of Stirling, Scotland, impd. kind of signal for communicating between persons travelling in railway carriages and the guards or conductors, or other officials in charge for the time of the train of which such carriages form part.

The above bear date January 12th.

108. Joseph Knight, of Manchester, impts. in the manufacture of crinoline skirts.
110. William Smith Longridge, of Alderwasley Iron Works, Derbyshire, and James Mash, of Bowden, Cheshire, impts. in furnaces.
111. William Brookes, of Chancery-lane, impts. in steam engines,—a communication.
112. Antoine Joseph Sax, of Paris, impregnating air for hygienic or therapeutic purposes, with the vapours or emanations arising from tar, creosote, or other suitable liquid antiseptic or antiputrid substances, or disseminating in the air for the said purposes suitable pulverized substances.
113. Richard Lewis, of Dublin, impts. in boilers for generating steam.
114. John Weekes, of Baker-street, Middlesex, impts. in umbrellas and other like articles.
115. Wilson Ager, of New York, impts. in machinery or apparatus for cleaning and decorticating grain.
116. Tommaso Guarnaschelli Pagano, of Colville-road, Bayswater, impts. in the construction and paving of roads and other surfaces.
117. William Wilkins, of Leicester, impts. in the manufacture of looped fabrics in warp machinery.

The above bear date January 13th.

118. Alfred Paul and Edwin Paul, of Everton, Liverpool, impd. hydraulic steering apparatus and rudder break.
119. George Davies, of Serle-street, a method of, and apparatus for, preventing incrustation or calcareous deposits in steam boilers,—a communication.
120. William Henry Richards, of Birmingham, impts. in sleeve links; which impts. are also applicable to other dress fastenings and ornaments.
121. Richard Lea, of King's-road, Chelsea, impd. apparatus to be employed for communicating between the passengers and guard of a railway train.
122. Richard Archibald Brooman, of Fleet-street, impd. apparatus or liquometer for ascertaining and indicating the strength of liquids,—a communication.
123. Alfred Vincent Newton, of Chancery-lane, impts. in machinery for pressing and cutting tobacco,—a communication.
124. William Ansell, of Birmingham, impts. in breech-loading fire-arms.
125. Theodore Bourne, of New York, impts. in fog and storm signals, buoys, and spindles,—a communication.
126. George Colven, of Dublin, impd. ornamental flower box.
128. John Lilley, of Bancroft-road, Mile-End, impts. in ship and other compasses.
129. Félix Clovis Fourgeau, of Paris, impts. in the construction of roofs or coverings of buildings.

The above bear date January 14th.

130. Jabez Bunting Farrar, of Halifax, and John Hirst, of Elstead, impts. in machinery for preparing, spinning, doubling, and winding wool, mohair, alpaca, silk, flax, cotton, or other fibrous substances.
131. Walter Edwin, of New Cavendish-street, Portland-place, impd. machinery for working all stage scenery in theatres.
132. Henry James Rogers and Jonathan Mather Scholfield, of Serle-street, Lincoln's-inn, impd. means of closing the mouths of bottles or other vessels.
133. William Rowbottom, of Romiley,

Cheshire, impts. in mules for spinning and doubling.

134. John Marshall, of New Cross, impts. in presses for the expression of fluids from substances containing the same.

135. Richard Archibald Brooman, of Fleet-street, impts. in driving rolls for rolling metals, and in apparatus employed therein,—a communication.

136. John Berkeley Cotter, of Wilton Lodge, Regent's Park, impts. in the construction of shells and in the explosive powder and fuse to be used therewith, and for other purposes.

137. Joseph Betteley, of Liverpool, impts. in ship building.

138. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in breech-loading fire-arms,—a communication.

139. James Simeon Edge the Elder, of Birmingham, impts. in breech-loading fire-arms.

The above bear date January 16th.

140. Richard Archibald Brooman, of Fleet-street, impts. in treating phosphates of lime and salts of potass and soda, in order to fit them for agricultural uses,—a communication.

141. Francis Henry Lakin, of Aberdeen, N.B., impts. in the manufacture and construction of pianofortes, or similar stringed instruments.

142. Sealy James Best, of Bermondsey-street, Surrey, and James John Holden, of Bow, impts. in apparatus for charging and drawing gas retorts, and for other purposes.

144. Charles Tiot Judkins, of Ludgate-street, City, impts. in sewing machines.

145. William John Cunningham, of Everett-terrace, Victoria Dock-road, impts. in apparatus for transmitting and converting reciprocating motion into rotary motion, applicable to various useful purposes.

The above bear date January 17th.

147. William Jeffreys, of Old Kent-road, impts. in machinery or apparatus for working switches and signals of railways.

148. Anders Bolœrn Bull, of Tonsberg, Norway, impts. in reefing and furling sails.

150. Stephen Ballard, of Colwell, Herefordshire, impd. method of cooking, and apparatus to be employed therein.

152. William Edward Newton, of Chancery-lane, impts. in breech-loading fire-arms,—a communication.

153. Joseph Burch, of Crag Works, near Macclesfield, impts. in looms and apparatus for weaving velvet-pile and terry-faced fabrics, and a certain mode of producing designs on such like fabrics.

154. James Coulter, of Huddersfield, and Herbert Harpin, of Holmfirth, impd. means or apparatus for facing flags or smoothing the surface of stones.

155. William Robert Foster, of Cowper-street, City-road, impts. in the packings of pistons and piston rods of pumps, and steam and other engines; which impts. are also applicable to hydraulic presses.

The above bear date January 18th.

156. Silvanus Frederick Van Choate, of New York, impd. system and apparatus for facilitating the working of submarine cables and other conductors of electricity.

157. Charles Denton Abel, of Southampton-buildings, impts. in the construction of watches,—a communication.

158. Thomas Mayor, of Pawtucket, Rhode Island, impts. in machinery or apparatus for preparing cotton and other fibrous materials to be spun.

163. George Francis Bradbury, of Oldham, impts. in certain sewing machine shuttles, and in the mode of, and tools for, manufacturing the same.

164. Robert Mallet, of Bridge-street, Westminster, impts. in the permanent way of railways, and in buckled plates to be used therein; the same being applicable to the construction of fire-proof buildings, bridges, and other like structures; also in the machinery or apparatus for producing such impd. plates.

165. James Alfred Shipton and Robert Mitchell, of Wolverhampton, impts. in shaping and forging metals, and in the machinery and apparatus employed therein.

167. Thomas Charles Durham, of Carlisle, impts. in locomotive and other steam engines.

169. William Clark, of Chancery-lane, impts. in the manufacture of boots, shoes, saddlery, harness, and other articles,—a communication.

The above bear date January 19th.

170. Donald Munro and Thomas Wright, of Glasgow, impts. in apparatus for painting blinds and similar articles.

171. George Adams Clark, of Milford-villas, Molesworth-street, Lewisham, impts. in projectiles.

173. John Hewes, of West Bromwich, impts.in puddling, heating, and other reverberatory furnaces used in the manufacture of iron and steel, and for other purposes; which impts. may also be applied to steam-boiler furnaces.

175. Charles Searle, of South-street, Grosvenor-square, impts. in apparatus for securing studs in shirt fronts and similar garments.

176. Benjamin Franklin Stevens, of Henrietta-street, Covent Garden, impts. in vulcanizing compounds and vulcanized fabrics,—a communication.

177. William Clark, of Chancery-lane, impts. in apparatus for taking up and delivering mails and other parcels in railway trains while in motion, —a communication.

178. John Snell and William Renton, of Leeds, impts. in facing woollen cloth and other textile fabrics.

179. William Mather, of Manchester, impts. in apparatus for facilitating communications between passengers, guards, and drivers in railway trains.

180. William Clay, of Liverpool, impts. in the mode of working hydraulic lifts.

181. William Edward Newton, of Chancery-lane, impts. in hammers and pile drivers, to be worked by steam or other power,—a communication.

The above bear date January 20th.

182. Henry Arnold Dobson, of Mary-le-bone, impd. carriage step arrangements.

183. Thomas Lester, of Wordesley, Staffordshire, impts.in steam engines.

184. James Godfrey Wilson, of Oakley-terrace, Chelsea, impts. in the construction of permanent way for railroads.

185. Alice Isabel Lucan Gordon, of Prince's-gate, Hyde-park, impts. in clasps and snaps, or other similar fastenings.

186. John Hays Wilson, of Liverpool, impts. applicable to pumps.

187. Charles Denton Abel, of Southampton-buildings, impd. apparatus for transmitting letter bags and parcels to and from railway trains whilst in motion,—a communication.

188. Jacob Snider, jun., of the Strand, impts.in fire-arms and in ammunition for the same.

189. Matthew Robinson, of Globe Works, Accrington, impd. machinery or apparatus for shaping the elastic dents of expanding and contracting combs.

The above bear date January 21st.

191. Christopher Brakell, William Hoehl, and William Günther, of the North Moor Foundry Company, Oldham, impts. in machinery or apparatus for ginning and cleaning cotton and other fibrous materials,—partly a communication.

192. Percival Moses Parsons, of Shooter's-hill-road, impd. process or method of treating articles of cast iron and of cast iron mixed with other metals.

193. James Badcock, of Noble-street, City, impd. method for the suspension of curtains.

194. Edward Atkinson, of Old Bond-street, impd. apparatus for containing and dispersing scents and other liquids.

195. Elton Templemore, of Dover, impd. window blind cord check.

196. Adolphe Dreville, of Paris, impts. in rendering soundless furniture and other articles for domestic purposes.

197. John Bland Wood, of Broughton, Manchester, impts. in the manufacture of floorcloths.

198. Alfred Sheldon, of Wookey Hole, Wells, Somerset, impts. in apparatus for drying paper in sheets.

199. Thomas Brown, of Piccadilly, impts. in folding chairs and other seats.

New Patents Sealed.

1757. Thomas Boyle.
1854. T. B. Heathorn.
1872. Richard Couchman.
1877. Alexander Prince.
1880. Elizabeth Brimson.
1882. J. Livesey and J. Edwards.
1883. Henry Moon.
1887. James Cope.
1889. Joseph Nicklin.
1890. Walter Payton.
1894. Henry Mc Evoy.
1896. H. J. Distin.
1898. G. A. Huddart.
1900. W. Payton and J. Stanley.
1901. Theodore Bourne.
1905. P. H. Moore.
1906. Edmund Tattersall.
1907. R. A. Brooman.
1914. Henry T. Davis.
1917. R. Kay, J. Manock, and G. Dakin.
1924. Matthew Woodifield.
1926. Edward Brazier.
1931. C. Garton and T. Hill.
1933. Alexander Bain.
1938. M. A. Soul.
1941. Francis Cruickshank.
1942. J. and M. Radcliffe.
1948. F. J. Bramwell.
1950. G. F. Marchisio.
1951. Joseph Heydon.
1952. James Lee.
1953. Isaac Farrel.
1955. W. R. Taylor.
1959. Richard Edmondson.
1960. C. W. Lancaster.
1962. Charles Bartley.
1967. W. Collins and W. Pountney.
1969. W. E. Gedge.
1971. Luther Young.
1975. E. & F. Crook.
1976. D. Speirs, A. Boyd, J. Aitkin, and M. Gilmour.
1977. William Richards.
1978. Mark Payne.
1981. William Clark.
1982. William Clark.
1988. Henry Armistead.
1995. James Russell.
1996. R. D. Edwards.
1997. Joseph Lang.
1999. A. V. Newton.
2000. James Milbank.
2003. J. Adam, J. Webb, and J. J. Monteiro.
2007. A. Alison and J. Shaw.
2009. Hugh Dyer.
2010. George Davies.
2012. Matthew Brown.
2019. William Richardson.
2020. George Bedson.
2021. J. B. Buffoni.
2023. J. Dilkes and E. Turner.
2024. W. H. Cox.
2025. A. C. Pilliner and J. C. Hill.
2029. Siegmund Moore.
2031. R. A. Brooman.
2032. S. & C. Collins.
2036. William Yule.
2037. William Dove.
2039. C. F. Darcagne.
2041. B. B. Stoney.
2043. P. A. le Comte de Fontainemoreau.
2044. William Dalziel.
2048. Thomas Wilson.
2051. Lewinski Yoose Laurent.
2108. Joseph Strouse.
2142. G. Furness and L. G. Moore.
2147. J. H. Johnson.
2188. William Clark.
2211. C. J. Newbolt.
2303. C. H. Robinson, J. Fryer, and A. Dyson.
2359. L. Alexander and W. B. Nation.
2391. Alexander Cuthell.
2460. B. Margulies and J. K. Leather.
2515. James Slater.
2565. W. E. Newton.
2582. William Ryer.
2665. R. A. Brooman.
2667. William Jackson.
2675. Alexander Parkes.
2701. William Rice.
2746. George Haseltine.
2756. R. A. Brooman.
2853. J. P. Nolan.
2854. John Rowley.
2873. G. T. Bousfield.
2973. C. J. Falkman.
2992. James Mc Intosh.
3042. G. T. Bousfield.
3047. W. E. Newton.
3091. Joseph Barnsley.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S
London Journal of Arts and Sciences.

No. CXXIV. (NEW SERIES), April 1st, 1865.

COAL: ITS ORIGIN OR MANNER OF FORMATION.

Article II.

We have seen that the term "*carbo maris*," or sea-coal, came into use at a very early period, and was no doubt employed in contra-distinction to the words "*carbo lignis*," the name then commonly given to charcoal. Within the last one hundred years, however, a new name has arisen, in consequence of the extended use of a variety of coal, which differs in so many respects from the *carbo maris*, or Newcastle coal, as to warrant this new appellation; although it happens, unfortunately, that the word chosen for the purpose is a corruption, and has passed into such general use as to require a notice at this point of our observations. About a century ago the celebrated Duke of Bridgewater was the proprietor of a large estate situated at a place called Worsley, seven miles from Manchester. This estate contained numberless valuable coal seams, easily to be got at, but nevertheless comparatively worthless, in consequence of the great expense and difficulty of transporting the coal to market. The Duke, being a singularly enterprising individual, determined, if possible, to remedy this defect, and by one of those happy coincidences which so frequently reward a praiseworthy effort, he found, in the self-instructed genius James Brindley, the very man to contrive the means for securing the desired end. Suffice it to say, that Brindley constructed an excellent profit-paying canal from Worsley to Manchester; and having thus gained the full confidence of his noble employer, the canal was soon afterwards extended by a branch running parallel to the River Mersey, and so arranged as to terminate in this river below the limit of its artificial navigation. Thus Brindley opened out a safe and extremely cheap route of inter-communication between Liverpool, Manchester, Worsley, and the Great Wigan district. This canal appears to have been finished about the year 1766, and store-houses were built at various points in its course, where the Duke's coal was deposited, for the purpose of supplying the immediate neighbourhood

At this time the word "kennel" or "kannel" was generally employed in Lancashire and Cheshire to designate an artificial watercourse; and even Brindley himself, in some of his letters, speaks of the new undertaking as "the Duke's kennel." It is not therefore surprising that the Duke's coal should have received the name of "kennel coal," being, so to say, kennel borne; and this name would be peculiarly applicable at Liverpool, where sea-borne coal from Whitehaven, in Cumberland, had long been in use, and was, moreover, an article differing in many of its qualities from the Duke's coal. That this is the true origin of the name now applied to this kind of coal is farther established by the fact that the eminent geologist Werner, who visited the coal districts of England not long after the above period, has adopted the very word, and in speaking of the Wigan coal calls it "kennelkohle." This word has indeed been lately written "cannel" in this country, and some ingenious persons, finding themselves quite at a loss to discover the source of such a name, have come to the conclusion that it is derived from the word "candle," and to support this they have asserted that slips of this kind of coal will burn like a candle; an assertion which we need hardly say is altogether fabulous.

Having now, as we think, sufficiently elucidated this matter, by showing that in pure English the proper name of this variety of coal is canal coal, we shall, in all our future remarks, so designate it; and, without farther controversy, proceed to examine the origin of coal itself, so far as this can be deduced by a thorough investigation of the nature, composition, and geological situation of coal obtained from almost every part of the world, where this mineral has hitherto been found; for it is a circumstance well worthy of observation, that coal is not largely diffused, and, unlike other mineral deposits, it is placed layer upon layer, and seam upon seam, so that mines of it may be worked to a profit in situations where a single seam, however valuable, could not have been worked.

The Formation of Coal.

Confided to proper hands, it would be difficult to point out a subject more admirably adapted for illustrating the active surveillance of a divine power over the ever-varying affairs of this world than may be found in a careful inquiry into the history of the coal formation, the slowly-accumulated treasures of which have been stored away and preserved by arrangements that admit of no explanation incompatible with the idea of a continued and continuous interposition of the Supreme agency. We know that ages upon ages must have rolled away since this accumulation was as perfect as we now find it. We know, too, that it must have been formed long ere the want of fuel seemed

possible to the human race; and yet but for this accumulation we are certain that man's power must speedily have reached its limit, and been confined to a comparatively narrow circle of barbarous activity: for, be it remembered, if we are now able to perform with ease those things which the most powerful nations of antiquity regarded as fabulous impossibilities, this arises solely from the fact that new and additional powers have been developed for our use, over and above those which they possessed. Had Augustus, for example, offered a kingdom as a reward to the man who should propel a large ship against wind and tide, at the rate of ten miles per hour, or transport several legions of his army as rapidly as a bird can fly, he might have raised a suspicion of his own sanity, but would not have excited the cupidity of the wildest schemer in his empire. Yet now these seeming impossibilities are but matters of coal and coke!

It is therefore sufficiently evident that man is a progressive agent in the development of some great plan, the details of which, being sympathetically unfolded in proportion to his wants and exertions, lend him new aid at the precise moment when his functions seem about to be arrested by the occurrence of a natural impediment to their exercise. Hence we may reasonably conclude that the industrial employment of the facilities now accorded to us will lead to the discovery of new ones, ere these are exhausted; and more powerful assistance will be given in proportion as the divine task imposed upon human nature becomes more and more difficult of execution. That the present supply of coal, like the past supply of wood, must one day cease, and necessitate the discovery of a substitute, is what every person feels and acknowledges; and although, therefore, we are as unable to conceive whence, or in what form that substitute will make its appearance, as were the Romans in the Augustan age to foresee the use of coal, yet no one can doubt that a substitute will be found in due place and season, more than sufficient for the increased exigencies of its own period. Science has already shown that the formation of coal, even under the most favourable circumstances, is an excessively slow process, so much so, indeed, as to preclude all hope of its simultaneous development and use; in fact, practically speaking, the generation of coal may be said to have ceased: consequently we are taught by the evidences of man's progressive nature, that a substitute exists, and will undoubtedly be found. Thus we have seen that the agency of vegetable life was unequal to the past wants of mankind, and still less, therefore, could it pretend to supply the demands of a coming age, more especially as an increase of human beings must lead to a diminution of the space already allotted to vegetation. Here was the barrier of the ancients, and here would have been for ever an

insurmountable obstacle to human progression. But not so; the difficulty had been foreseen and provided against. The moment the door was knocked at, it opened, and a supply of fuel was found to exist in situations easily accessible to industry, and which detracted nothing from the claims of the vegetable world. The corn that sustains the collier during his subterranean labour grows in the sunshine freely, many fathoms above his head, and this enables the earth to realise a double duty in apparently opposite directions; furnishing at once the food for animal life and artificial heat—fuel for the lungs and fuel for the furnaces.

If now we proceed to examine the arrangements by which the wants of future ages have thus been provided for out of the surplusage of a preceding era, we are so struck with the simplicity of these arrangements as to lose sight of every other consideration. The means employed seem so easily reconcileable to human reason that we hesitate to recognise the hand-work of an All-wise Being, and feel inclined to exclaim: "This is a matter of course; it must have been so; it is a natural consequence!" forgetting that simplicity is the attribute of perfection.

Every form of matter which has been brought into a state of combination by the effect of vitality is prone to death, decomposition, and decay; hence, what are called organic bodies, or the substances derived from the animal and vegetable kingdoms, for the most part display a strong tendency to corrupt and putrefy. The preservation of vegetable matter during many ages is therefore of itself a most difficult task; but in the case of coal we shall see that much more than this has been accomplished, for the coal possesses actually three times the heating power of the dried vegetable which produced it; so that not only has there been the most perfect preservation of the constituents needed for man's use, but, moreover, those parts have been got rid of which were either worthless or injurious to the desired object. Now this is the precise point at which we may notice the intervention of a specific agency, or what some may be disposed to call the effect of an "exceptional law of nature." That the result is diametrically opposed to what ensues under the operation of the ordinary laws of nature is beyond dispute, and fully demonstrated by the change induced in a piece of wood long and deeply buried in the earth. Such a piece of wood, so far from having preserved or relatively increased its calorific powers, is found to have lost them almost entirely, and to have become nearly incapable of burning: whereas, in the case of coal, these have been maintained and concentrated. To overlook this specific intervention or exception, in any attempt to explain the formation of coal, is tantamount to throwing away the key which alone can unlock the

whole theory. Yet, as we shall hereafter show, much chemical argument has been heaped together, with a view to explain the origin of coal upon principles that stand contradicted by the best established facts of that very science which is supposed to uphold them.

The justly celebrated Berzelius, in the last volume of his "Treatise on Chemistry," with great reason condemns the unwarrantable speculations of Liebig in reference to the presumed changes which organic matter undergoes under various circumstances. This tendency to supersede the labours of the laboratory by a fanciful pen and ink sketch at the writing desk is a prevailing sin with what may be called "organic chemists," who, having begun at the wrong end of chemistry, remain for ever enveloped in a kind of moonshine fog. Persons labouring under this unhappy delusion discard altogether the irksome preliminaries of the Baconian philosophy; and, provided the two ends of a chain be visible, hesitate not to supply what they regard as the intervening links: just as if a man, having seen another in London and afterwards in Edinburgh, had therefore a right to assert that he must have passed through York. "Because sugar, starch, and gum," says Liebig, "cannot in the animal economy produce nitrogenised elements, therefore they must go to form fat." Accordingly, having satisfied himself thus comfortably with a most groundless assertion, he next builds upon it a chemical theory, out of the hashed-up elements of sugar, starch, and fat, the result of which is, that if we only take away from starch $\frac{9}{10}$ths of its oxygen, and $\frac{1}{12}$th of its carbon, we have fat remaining. In support of this he tells us, "starch is composed of C^{12}, H^{10}, O^{10}, and if one atom of carbon combines with two atoms of oxygen to form carbonic acid, and seven atoms of oxygen will only combine with something else, or go away (he says not where), then there remains C^{11}, H^{10}, O, or the chemical formula of fat."

How this combination of carbon with oxygen, to the exclusion of the more oxidisable hydrogen, is to take place, was of course beneath the notice of so great a theorist; as also how it happens that seven atoms of oxygen are willing to quit a compound which, like fat, has (we are afterwards told) so great an affinity for oxygen that it burns totally away in the lungs, and generates heat. Considerations of this kind, we presume, clip the wings of speculative genius too much, and are therefore out of place in organic chemistry: the plan is, to make a theory, and then construct facts to suit. Berzelius has called this sort of reasoning "the physiology of probability," and he very pertinently asks what will become of the science of chemistry—"that science which is so beautiful and elevated in its nature, where every step requires such profound, extensive, and varied researches: what will become of this science if we bolster it up with the results of mere

calculations which have so little real foundation?" This question has for some time back received a practical answer, in the universal distrust with which British manufacturers and agriculturists everywhere regard the followers of this pen and ink system; indeed, the money lost through its agency in farming alone would astonish any person unacquainted with the credulity of John Bull: it is not without reason he now shakes his head. Precisely similar to the formation of fat is the theoretical formation of coal. In the case of fat we have seen the theoretical chemist able to do that which nature could not. At his command the oxygen conveniently betook itself elsewhere, and quietly left the carbon in full possession of that hydrogen for which it had chemically little or no affinity. The oxygen contained in lignin would appear to have been no less obsequious during the production of coal. It is not our intention to occupy much space in detailing this additional instance of the "physiology of probability;" suffice it to say, that the theorist has chosen lignin as the parent of coal, and there is this advantage peculiar to the method he employs, viz., that any other organic compound whatever would have answered his purpose equally well. Fat, as has been shown, can be theoretically made from sugar; and, by a similar process, coal may be made from the same substance—nay, even diamonds can be thus formed, in any quantity, and of any required size. Sugar is composed, in round numbers, of 42 parts of pure carbon and 58 parts of oxygen and hydrogen. If, therefore, we make the oxygen and hydrogen combine to form water, there will remain 42 parts of pure carbon, or diamond, according to the "physiology of probabilities"—*quod erat demonstrandum.*

Lignin is composed of carbon, oxygen, and hydrogen, and coal being constituted essentially of the same elements, nothing of course can be easier than theoretically to make the one into the other. We have only to assume a certain plasticity in the chemical affinities concerned in the change, and the thing is done as readily as the diamonds were produced from sugar.

Thus, for example, if we regard lignin as composed of C^{12}, H^8, O^8, and coal of C^{11}, H^3, O, then, as in the instance of the fat formation, we may conceive that $\frac{1}{12}$th of the carbon combines with one-fourth of the oxygen, to produce carbonic acid, whilst $\frac{5}{6}$ths of the remaining oxygen combine with $\frac{5}{8}$ths of the hydrogen to form water, and nothing but coal remains.

Therefore, lignin or woody fibre, when buried in the earth, ought to resolve itself into carbonic acid, water, and coal.

A man need not use his hands much to be a chemist after this fashion, and whatever benefit the atomic theory of Dalton may have conferred

upon science, when honestly employed, there is, unfortunately, good proof that it has been made a fruitful source of deception by many, who have superseded the onerous use of test tubes and crucibles with the lighter labours of pen and ink. Meanwhile the real chemist will always find consolation for the slow and painful nature of his toil in the solidity and durability of its results. For him the day of trial is a period of triumph; and as he witnesses the successive collapse of the various theoretical bubbles which have temporarily gilded their originators with a mock halo, he cannot fail to congratulate himself upon the firmness of his own less showy but more enduring reputation. He will then remember the sagacious remark of Berzelius, "*Plus la physiologie de probabilité prend le dessus, plus on doit être reconnaissant à ceux qui restent dans le sentier de la véritable science, qui est plus sûr mais plus pénible.*"

The great diversity noticeable in the character and composition of coal is a sufficient proof that n › one substance has been alone concerned in its formation; and hence we see at once the absurdity of those pen-and-ink deductions which have assumed lignin, or any other single substance, as the parent of coal. True, indeed, the theorists of this class have attempted to explain the differences in coal as the effects of age and accident of position; but, in so doing, they have only rendered their theory more ridiculous. In the first place, there is no reason whatever for supposing that the more hydrogenous or canal coals are less aged than common coal; and, in the second place, it is anything but probable that canal coal, however placed, can become converted into common coal. If, however, this question were one which admitted of a greater amount of doubt than, in our opinion, can be raised upon it, the argument must fall altogether when we find, as is quite usual in the coal fields of Great Britain, that common coal and canal coal alternate with each other in the same formation, or are actually contained in the same seam—the one above the other, or alternating in layers. Indeed, the canal is sometimes interposed in the centre of a single seam of common coal, as happens in the well known Pelton, Washington, and Leverson's gas coals from the Newcastle district, and in the Ruabon and Brymbo coals of the North Wales coal field. Had these coals been produced from any one substance they must have been uniform in character throughout the same seam; for it is needless to add that the whole has been uniformly subjected to the same circumstances of time, temperature, pressure, and so forth. Here is, consequently, an end of the lignin theory, even if stronger proofs of its fallacy could not be drawn (as they certainly may be) from the nature of the Boghead and other similar coals, as well as from the fact that the common kinds of bituminous coal invariably contain thin layers

of mineral charcoal, interposed between their ordinary jet-like laminæ of true coal.

The celebrated Dr. Hutton conceived the idea that coal resulted from wood which had been subjected to a great heat when surrounded by water under an enormous pressure. With true principles of philosophy, he attempted to demonstrate the correctness of his opinion by actual experiment, and seems to have satisfied himself, at least, that he had produced real coal by exposing wood and water in a strong vessel to a heat approaching 400° Fahr. This experiment has been repeated by several chemists, who, however, have drawn a very different conclusion with regard to the nature of the resulting product, which, indeed, appears to resemble coal in little beyond the darkness of its colour. Having an opportunity some years ago of subjecting wood to a high temperature under the conditions prescribed by Hutton, we made a great many experiments upon this subject with various kinds of wood, and found, in effect, that nothing like true coal can be made by this means, even at a heat of 450° Fahr.—beyond which the experiment becomes dangerous. The more resinous species of wood, such as that from Memel and good Scotch fir, answer best; but, although the mass which remains from these woods has the black colour and vitreous fracture of coal, yet, when acted on by naphtha, æther, and sulphuret of carbon, it is largely dissolved, and the residue being boiled in a solution of caustic potash speedily affords a dark brown liquid, having all the chemical qualities of the humate of potash: moreover, the heating power of this substance is less than one-half that of coal. Whilst, therefore, we cannot too highly appreciate the correctness of the principles upon which Dr. Hutton sought to establish the accuracy of his views, we are compelled to differ widely from him respecting the conclusion he drew from his experiments—he never made true coal. With such instances of erroneous theory before us, it may naturally be supposed that we should hesitate to advance any opinion of our own upon the subject; and indeed we are about to recapitulate a series of undeniable facts, all tending in the same direction, rather than dogmatically to insist upon the conclusion to which they point—thus every one will be at liberty to draw an inference for himself.

Nature, in her greatest and most powerful operations, seems constantly to employ the weakest and most insignificant forces; a fact of which we see examples in the disintegration of the hardest rocks by the expansion of thin filaments of water in freezing; the production of large islands (as in the Pacific Ocean) by insects, so small as to be almost invisible; the destruction of the hardest steel by the slow action of moist air; or, turning our eyes still nearer home, let us look at the immense cliffs and deposits of chalk everywhere to be found in the

southern parts of this island. Well, the celebrated microscopist, Ehrenberg, has shown, by covering a portion of this chalk with Canadian balsam, and then exposing the chalk to a moderate heat, that, with the aid of a microscope of 300 diameters, the chalk stands revealed as an accumulation of shells belonging to the polythalamic class of insects: some of these shells are broken, but the greater number are whole; and the number existing in a single cubic inch of the chalk is between one million and one million and a-third!

We are not, therefore, compelled to conclude that forests composed of large trees were essential to the formation of coals, inasmuch as, guiding ourselves by the above analogies, it would appear more probable that some of the smallest forms of vegetable life were employed for this purpose—an opinion in accordance with what we see at present in the formation of peat. Again, we know that the most indestructible compounds yielded by vegetables are of the waxy and resinous kinds, of which we may notice a remarkable example in common amber. This substance has evidently flowed from a tree, as copal now exudes; and we see that it has not only preserved its own elements unaltered, but even insects and the parts of flowers most liable to decay have been completely protected by it for ages. Thus, in the cabinet of the Natural History Society at Upsal, there is a piece of amber which encloses the corolla or flower of a plant now unknown, but perfect and seemingly as fresh as when first blown. If, therefore, a plant or vegetable containing wax or resin in small quantity came to be exposed to the destroying influences of time, air, and moisture, the probability is that the waxy and resinous portions would long outlast the woody fibre, and remain when, by the production of humus, humic acid, &c., the rest of the vegetable had entirely disappeared.

The quantity of waxy, fatty, or resinous matter contained in vegetables is, moreover, much larger than is generally supposed, and in the case of aquatic plants seems to be very considerable indeed, more especially amongst the class cryptogamiæ. There is no doubt a providential arrangement here, without which the functions of this class could not be discharged, standing as it does in the very lowest part of the scale of vegetable life, and consequently requiring some additional provision. According to the latest researches of Messrs. Dumas and Payen upon a great variety of vegetables, hay and dried lucerne contain, the former from 2 to 4 per cent., and the latter 3½ per cent., of fatty matter; but even the highest of these is much inferior to that afforded by the ordinary alpine plants which grow in bogs and damp elevated situations, for we have extracted as much as 7 per cent. of greasy or resinous matter from the dried leaves of these plants by the action of chloroform and æther. It is known, too, that aquatic birds and amphibious animals

secrete upon their outer surfaces a large amount of oily matter, which has the effect of protecting them from the action of the water in which they find their food; and something of the same kind evidently holds good with respect to many vegetables, both terrestrial and aquatic. Thus, plants with large leaves, such as the common cabbage, secrete a waxy matter that, by interdicting capillary attraction, prevents their being borne down under heavy falls of rain, which not unfrequently saturate and destroy meadow grass. The leaf of the common water-cress, though of the same natural order as that of the radish, exhibits a striking contrast when both are kept immersed for a few hours in water; and hence it need not surprise us if we find, as is really the case, that the minute mosses, lichens, and other cryptogaminous plants which grow in watery situations, are able to cover themselves with a waterproof secretion which protects their delicate conformation from the dangers that surround them. Moreover, as these plants possess little or no internal substance, but consist almost wholly of surface, it follows that this waterproof composition must form a considerable part of the weight of the dried plant; and, for the same reason, we might expect, as a general rule, more waxy or resinous matter in endogenous plants than in those of the exogenous kind—facts capable of easy demonstration.

Again, coals, when distilled, are found to afford products which vary with the nature of the coal, and are sometimes of a waxy or fatty quality and sometimes resinous: thus the canal coals of the south of Scotland—and more particularly the Boghead, Capeldrae and Wemys coals—yield compounds of the former kind, whilst the common bituminous coals of the Newcastle and Durham district give products of the latter description—the Wigan canal coal affording a mixture of these. If, now, we call to mind the easy destructibility of the woody part of plants compared with the great resisting power of their waxy and resinous portions—if we observe with care what is now going on before our eyes in peat bogs, where the humus and humic acid, being dissolved by the water, are carrying away the woody part and leaving the waxy—if we notice the vegetable impressions existing in the coal strata, and examine attentively the different kinds of products obtained by distilling different kinds of coals—and, lastly, if we consider the great heating power of coal as compared with any kind of dried vegetable matter whatever, we shall find ourselves drawn very forcibly to the opinion that the enormous masses of this mineral now existing in our coal measures owed their origin to the waterproof covering of plants which probably vegetated in a warm and humid atmosphere, and, therefore, grew and decayed with great rapidity—the humus from one crop constituting the food of a subsequent and perhaps different species.

So far as can be determined by microscopical examination, none of the plants indicated—by inspecting the remains of those in the coal formation—now exist; consequently, we may regard the formation of true coal as finished, and but imperfectly represented by our present lignite and peat deposits. As regards the formation of true coal, it is not difficult to conceive that small aquatic plants may have flourished on the surface of lakes, and afterwards fallen—in succession, day after day and year after year—to the bottom, where they have accumulated until the occurrence of a flood or convulsion has covered them with a layer of the disintegrated débris of the primary rocks—such as granite and felspar—in the form of clay slate or fire clay, as we now find them; and such an accumulation may represent what is termed a seam of coal, the thickness of which would be in proportion to the rapidity and duration of the accumulated deposit; whilst a series of accumulations and coverings, by gradually filling up the lake, may be supposed to have originated a coal basin or formation, the coals contained in which might be of very different qualities, not only as between the various seams, but in respect to different parts of the same seam, as we now find them. Moreover, it must be borne in mind that at this epoch of the earth's existence there were positively none of the tertiary and diluvial deposits so essential to the growth of large exogenous trees, whose roots require a deep soil for their development and for the support of their wide-spread, heavy branches and twigs; nor are the coal measures ever found associated with such deposits, but resting upon the transition series, and sometimes below even the old red sandstone and magnesian limestone.

Thus, then, we have an arrangement of the known facts connected with the history of coal; and if the conclusion which we have ventured to propose be correct, it will only prove another instance of the well-known disposition of Nature to perform her greatest works by what appears to us the most insignificant and unlikely means. If, however, our surmise (for it is no more) be wrong, we have the consolation of thinking that it may assist in revealing the truth; and it certainly agrees with a fact which may be noticed every day—viz., that even single leaves of plants are to be found in the strata surrounding the coal measures perfectly converted into coal, although far removed from every effect of fermentation; and, what is still more deserving of notice, the coal of these leaves is generally of a different kind to that of the coal to which they are attached: thus the coal of the leaves of sigillaria in the Boghead coal is not canal, but common bituminous coal—as if the waterproof covering of the sigillaria plant had been of a resinous nature; whilst that of the plants which generated the coal itself was waxy.

(To be continued.)

Recent Patents.

To Edward Beanes, *of Argyll-street, and* Conrad William Finzel, *of Bristol, for improvements in sugar boiling.*—[Dated 5th May, 1864.]

This invention consists in the use of hot water at, or as near as may be, to the boiling point, or of very low pressure steam, for boiling sugar in vacuum pans.

Hitherto, for such purposes, steam has been used at temperatures of 225° Fahr. and upwards, equal to a pressure of 4½ lbs. and upwards, whereby there has always been more or less carbonization, and consequently colouring of the sugar; for it has hitherto been deemed necessary to use steam of such high temperatures in such process in order that sufficient heat may be obtained throughout and at the end of the worm or tubes used in such vacuum pans, to cause the proper evaporation of the syrup or liquor.

Now the present invention consists in using hot water continuously kept at, or as near as may be, the boiling point; or steam at a temperature not exceeding 215° Fahr., or at a pressure not exceeding 1½ lbs. to the square inch, or as near to such temperature and pressure as it can be kept in practice so as to boil the syrup or liquor without carbonization. To effect this object, the patentees dispense with the use of the vacuum pan with such worms, and employ a tubular vacuum pan, reducing the length of the tubes therein, and increasing at the same time the number of tubes according to the evaporating surface required; so that it will only be necessary for the heating thereof to use hot water or steam at a temperature below the carbonizing point of saccharine syrups; while, from the shortness of the tubes in the pan, the water or steam will continue sufficiently hot during its passage through such tubes, so as to be perfectly effective for the purpose of boiling the saccharine liquids, and causing the proper evaporation throughout the pan without causing any carbonization and colouring of the sugar.

To Joseph Freeman, Edward Grace Freeman, *and* Charles Henry Freeman, *of Bridge-road, Battersea, for improvements in treating oil and spirit varnishes, and also drying oils and turpentine, in order to bleach and otherwise improve the same.*—[Dated 19th May, 1864.]

In order to improve the color and quality of oil varnishes, which consist principally of gums dissolved in drying oils, the patentees place them in a close vessel, which they partially fill with the varnish, and the remaining space in the vessel they fill entirely with oxygen gas. By rotating the vessel the varnish is agitated with the gas, or, by other means, varnish may be brought into intimate contact with pure or nearly pure oxygen gas. Before treating the varnish in this manner, it should be allowed to get perfectly clear and fine, by standing for two or three months, until the driers used in making the varnish are entirely deposited. In this manner the color of the varnish is in part discharged, and its quality is in other respects improved. Spirit varnish, and also linseed

oil, boiled linseed oil, and other drying oils and turpentine, may be similarly bleached and improved in quality. By preference, a cylindrical vessel on axes is used, into which the material is to be introduced, and the vessel is to be closed air-tight. The atmospheric air is to be removed by air pump or otherwise, and the remainder of the space filled with oxygen gas. The vessel, or the material therein, is to be agitated till the oxygen gas is absorbed, when a further quantity of gas is to be introduced, till the degree of color desired has been obtained, or the material will no longer absorb the gas.

To THOMAS DUNLEVIE, *of Dublin, and* JOHN JONES, *of Liverpool, for improvements in metallic alloys*—[Dated 19th May, 1864.]

THIS invention relates to the production of a new metallic alloy to be employed for the bearings of shafts or frictional surfaces in machinery, "rolling stock," &c.

The improvements consist in the combination and use of spelter and block tin, to which is added a small quantity of copper and a small amount of antimony, and the mode of combining the above in the melting pot is as follows:—

First, take four ounces of copper, melting or fusing it in any ordinary crucible. When fused, add 16 ounces of block tin, and 1 ounce of antimony; and when the whole are melted together, pour the compound out into a mould. Then melt in a separate vessel 128 ounces of spelter, together with 96 ounces of block tin, and when both are fused, add the above ingot of copper, tin, and antimony, and fuse altogether: when properly fused in these proportions, or thereabouts, the alloy is complete. The chief features of this alloy are great durability, and its low temperature when under the heating influence of friction.

The component parts being 16 lbs. of block tin, 18 lbs. of spelter, 8 ounces of copper, and 2 ounces of antimony; take the 8 ounces of copper, and add thereto the 2 ounces of antimony, and fuse them together: then add double the quantity of block tin, and when mixed pour out into an ingot mould; then melt the 18 lbs. of spelter, and add thereto the remaining portion of the block tin, and when these are fused and well mixed, add the ingot previously made thereto. For lining bearings, journals, &c., the bearing is to be tinned, in the ordinary method, with block tin and sal-ammoniac. The improved lining alloy is then gradually fused, and the bearing heated, until it will fuse a solid strip of the alloy. A heated shaft, or mandril, is then enclosed in the bearing and mould, and the alloy poured in between the bearing and the shaft, where it remains until it hardens; the bearing is then taken from the mould lined with the alloy.

The patentees claim, "the novel combination and use of the aforesaid materials to form an improved metallic alloy for lining or covering frictional surfaces, as hereinbefore described and set forth."

To GEORGE HOMFRAY, *of Halesowen, Worcestershire, for improvements in the mode of making or forming the links of iron or steel chains, chain cables, shackles, couplings, or part of the same, and for machinery to be used therein.*—[Dated 19th May, 1864.]

THE patentee takes bars of iron or steel, either hot, direct from the rolls, or cold, and coils them upon a mandril or bar of such a shape, and distributed upon the mandril or bar in such a manner, that the coils, when cut into pieces, shall form links of the required shape and size; and having scarfed, or spliced, or other joints used by chain and chain-cable makers, and with sufficient openings between the joints to allow of their being linked together and closed up before being welded; he also cuts the coils and links the pieces together, and closes up the joints by machinery.

This machinery consists of a mandril of the shape of the link required, fixed into a headstock having driving gear, speed wheels, and reversing and stopping motion. A collar, turning in a carriage, is fitted upon the mandril, and is made to slide upon the bed from end to end of the mandril, to discharge the coil. The end of the mandril, opposite the headstock, is supported by a carriage, which is made to slide out and fall out of the way, to allow the coil to pass on to a bar connected with the shears or saw. A tool, fitted into a rest or saddle, is made to slide from end to end of the mandril, to give direction to the bar of metal and regulate the pitch of the coil.

A sliding collar and carriage is also carried upon the sliding rest or saddle, when required, to prevent the mandril from springing during the process of cooling.

To JAMES WEBSTER, *of Birmingham, for improvements in the preparation of paints or varnishes.*—[Dated 8th February, 1864.]

THE object of this invention is to prepare paints and varnishes that possess the important properties of drying quickly and being impervious to most acids, the latter property rendering the paints or varnishes particularly suitable for covering metals and protecting them from oxidation.

In carrying out this invention, a mixture, composed of asphaltum, rosin, and boiled oil, is used, as a vehicle for applying the pigment to be presently described, or for combining, with any ordinary pigment, to produce an anti-corrosive paint or varnish. This mixture, or vehicle, is prepared in the following manner, the proportions given being preferred:—Take two parts, by weight, of asphaltum (by preference the solid residuum from the distillation of gas tar), and reduce the same to a fluid state, by submitting it to heat in an iron vessel. When well melted, add thereto three parts, by weight, of rosin (by preference black rosin), applying it in small quantities at a time,—continuing the heat, and stirring occasionally, until the whole is melted and well combined; then add to the mixture six parts, by weight, of boiled oil, in small quantities at a time, and stir, as before, until the whole is well mixed. This liquid compound is called mixture No. 1.

The pigment called mixture No. 2 is made as follows:—Take of carbonate of copper (carbonate of the protoxide preferred) seven parts,

by weight, and of oxide of zinc (by preference precipitated oxide), three parts, by weight, and grind them well together in a small quantity of turpentine or mineral naphtha, in the ordinary way of grinding colours.

In preparing the anti-corrosive paint or varnish, take of mixture No. 1 eleven parts, by weight, and combine it well with twelve parts, by weight, of mixture No. 2, or with any other ground pigment that may be preferred; and then add three parts, by weight, of mineral naphtha or turpentine, or other suitable spirit: reduce the paint or varnish to the requisite fluidity for working easily with the brush. This paint or varnish, when applied to metal surfaces, will dry quickly, and the application of two coats will effectively protect the painted surface from the action of moisture and even of muriatic acid.

The patentee claims, "the use, in combination, of asphaltum and boiled oil in the preparation of paints and varnishes, as above described."

To WILLIAM EDWARD NEWTON, *of* 66, *Chancery-lane, for an improved process for cleansing or clarifying impure water,—being a communication.*—[Dated 7th July, 1864.]

THIS invention relates to the purifying of impure river or other water by means of a simple chemical process, whereby organic and other impurities contained in the water will be precipitated, and may then be collected and removed.

The chemical agent it is proposed to employ to effect this object is a solution of the neutral sulphate of peroxide of iron ($Fe_2, O_3, + 3\ SO_3$), which is to be added, in a very diluted state, to the water intended to be operated upon.

The proportion in which the solution of neutral sulphate is to be added to the water, for the purpose of the invention, must be determined by the amount of the impurity contained therein. The suitable proportions must therefore be ascertained, by careful experiment carried on from time to time, if it should be found that the impurity of the water varies.

The patentee remarks, that the addition of more or less of the neutral sulphate will not materially affect the process beyond the evident fact that too dilute a solution of the salt would probably either leave some of the impurities in the water or the purifying process would go on too slowly. On the other hand, too strong a solution would be more costly than would be necessary for the complete success of the process.

The water to be purified may be run into a tank or reservoir, and the solution of neutral sulphate added thereto as it runs in, so that the solution may be well mixed with the water to be purified. A short time after the neutral sulphate is added to the impure water, it becomes decomposed, and forms, with some of the impurities contained in the water, a basic salt, which is insoluble in water.

The solid and insoluble particles of this new salt are precipitated, and, together with the impurities contained in the water, form a sedimentary deposit, from which the purified water may be allowed to run

off, leaving behind the sedimentary deposit in the tank or reservoir. A repetition of this precipitation process on other bodies of water which may be run into the same tank or reservoir will cause additional deposits, which, when they have been allowed to accumulate to a sufficient depth in the reservoir, may be collected, and removed from the reservoir from time to time.

The patentee claims, "cleansing or clarifying impure water, by the addition thereto of a solution of the neutral sulphate of the peroxide of iron in any suitable proportion, as herein set forth."

To JAMES BROWNING, *of Grosvenor-road, Pimlico, for improvements applicable to street and other lamps or lanterns.* — [Dated 18th May, 1864.]

THIS invention relates to an improved mode of utilizing those rays of light which radiate upwards from the burner of street lamps, and thereby become lost. The object is effected by adapting to the lamp or lantern reflecting surfaces, arranged in such a manner that all or a greater portion of those rays of light which radiate upwards are made to fall upon the reflecting surfaces, and are thereby thrown downwards or in a horizontal direction, so that the rays of light may be dispersed in the direction where they will be required.

The figure in Plate VIII. is an elevation of a common street lamp with the improvements adapted thereto. It will be seen that two distinct and separate reflectors are used in combination, and that the reflecting surfaces are arranged at an angle of about 45 degrees to the ground. One of the reflectors *a*, *a*, is to be placed outside the lantern above the light, so that the rays, when they strike the reflecting surface, may be reflected downwards to a considerable distance from the burner, and also on to another reflector *b*, which is placed inside the lamp; and the burner *c*, passes up through it, and is so adjusted that a portion of the rays of light from the burner strike on the outside surface of the reflector *b*, and a portion on the inside surface of the same reflector. Both sides of the reflector *b*, are therefore utilized: the under side will throw or reflect the light at an acute angle to the ground, while the upper side of the inside reflector will throw some of the rays up on to the surface of the upper reflector outside the lamp; and this reflector will throw them back towards the earth, but at an acute angle, as before mentioned, or nearly in a horizontal line, so that the light from all the reflecting surfaces will be dispersed and thrown in the direction where it is required, instead of being lost, as is now the case. It will be seen that the inner surfaces of the external reflector *a*, *a*, are prevented, by means of the corner pieces *e*, *e*, and flanges *d*, *d*, above, from resting on and being sullied or dirtied by coming in contact with the glass. The internal reflector *b*, is also provided with a vertical flange, which will raise it up above the level of the frame of the lantern.

The patentee claims, "the mode herein set forth of adapting reflecting surfaces to lamps or lanterns, for the purpose of intercepting those rays of light which would otherwise become lost or useless, and throwing them downwards, or in a horizontal or nearly horizontal direction."

To JACOB SNIDER, Jun., *of Great Carter-lane, City, for improvements in breech-loading ordnance and projectiles.*—[Dated 7th April, 1864.]

THIS invention relates, first, to cutting the hole to receive the moveable breech piece or block. The breech piece may have its upper portion dispensed with, in order to reduce the weight of the moveable breech piece, or breech block, and render it easier to manipulate or work.

The second part of the invention consists in certain arrangements of mechanism for opening and closing the breech block.

In Plate VIII., fig. 1 is a rear end view; fig. 2 is a longitudinal section through the line *a*, *b*, *c*, *d*, of fig. 1; and fig. 3 is a vertical section through the line *e*, *f*, of fig. 2, of a breech-loading gun, or piece of ordnance, constructed according to the invention. A solid arm or axle *g*, is passed through the rear part of the gun *h*, and through a hole or receptacle in the breech block *m*. The opposite end of this arm or axle *g*, rests in a receptacle in the solid body of the gun forward of the breech block. This axle *g*, has its largest diameter at its rear end, where it rests in the body of the gun in the rear of the breech opening, and its smallest diameter is at its forward end, which rests in the body of the gun forward of the breech block, while the intermediate portion *i*, which fills the receptaclo for the axle in the breech block, is excentric to its axis. The larger diameter portion has cut upon it a male screw thread *k*, of such spiral as shall be equivalent to the angle of the rear face of the breech block. The excentric portion *i*, of the said axle contains a slot or groove *l*, on its face, parallel to its axis, which bites, or takes hold of, a ridge or lump provided in the receptacle for the axle in the breech block *m*; the breech block *m*, is then attached to this axle by means of a screw or screws *n*, or other fastening. The female screw, into which the male screw on the axle works, is cut inside a cylinder *o*, which is secured firmly in the solid of the gun, rear of the breech block. In small ordnance a full male screw on the axle, and the cylinder to receive the screw, are dispensed with, and an angular groove merely is cut in the axle, and a pin is let into it through the body of the gun; so that, in turning the axle, the angular groove on it will impinge on the pin, and back the breech block as it is lifted. It will thus be perceived, that by giving the axle one simple turn of less than one-fourth of the circumference, the block *m*, will be lifted, as shown by the dotted lines in fig. 3, and the gun made ready to load, and a reverse quarter turn of the axle will close the bore for firing, as shown by the full lines in the same figure; while at the same time the breech block will be lifted, and simultaneously cause its forward vertical face to be freed from the barrel face, and from the face of the gas check. A handle *t*, is fitted to the axle, to facilitate the turning of the same.

The third part of the invention consists of an improved gas check, for preventing lodgement of fire in the chamber or bore of the gun, from *débris* of a cartridge after discharge. A closer fit than heretofore obtained is given to the forward face of the gas check; and it is caused still to recede against the face of the breech block on explosion of the powder charge. A portion of its interior annular face is curved out in such manner as to leave all around the interior face a recess or cavity, so that on explosion of the powder charge,

the gas check will not only be driven back to close the breech joint, but any deposit of ignited *débris* from the cartridge envelope remaining in the chamber or bore will be prevented.

The fourth part of the invention is as follows:—The bolt o^1, fig. 3, in larger-sized ordnance, is made to pass entirely or partially over and across the top edge of the breech block, as shown in fig. 3. Its forward end enters a hole to receive it in the solid of the gun, in which case it would not be self-locking or latching.

The fifth part of the invention consists in preventing the shock of the explosion affecting injuriously the adjustment or working of the breech block, or the axle, or its fastenings. For this purpose a little play is given to both the screw or fastening by which it is attached to the breech block and the face of the excentric, and also the slot in the axle which forms the leverage by which the breech block is mainly lifted; the said play of the screw or fastening, and on the excentric, being proportioned the one to the other, so that when the axle is turned, the screw will cause the breech block to recede precisely simultaneously with the excentric, bearing on and lifting the breech block.

The sixth part of the invention consists in covering the opening for the breech block, in the solid outer surface of the gun, with a copper or other suitable metal lid or apron p, (fig. 3) hinged to the gun; so that when the breech block rises, the cover of the lid will lift, and as the breech block descends or closes, it will shut; or this lid or cover may be operated to open and shut by an attachment r, fitted to the top edge of the breech block; and when the gun is not in use, it may be fastened by a latch or otherwise. The space between the lid and the breech block is sometimes filled with a block of cork or wood: q, is an aperture formed through the lower portion of the gun, extending from the base of the receptacle for the breech block to the lower surface of the gun, for the passage or escape from the said receptacle of dust or dirt that might accumulate there by the continued opening and closing of the breech block. It is preferred to make this aperture somewhat conical—larger at bottom than at its upper end, and as shown in figs. 2 and 3. r^1, r^1, are small studs inserted at the base of the aperture for the breech block, on which the said block rests when closed for firing, as shown in figs. 2 and 3.

The seventh part of the invention consists in cutting grooves into the projectile along that portion of its flanges which most impinge on the riflings in the bore of the gun. Into these grooves is compressed a composition, made of any suitable material, which shall form simply a medium or vehicle to mix with and retain or convey graphite in a densely-compressed form, and to hold the said graphite firmly in place in the grooves, and so that the said compressed graphite composition will have a face very slightly elevated above the metal surface of the body of the shot or projectile. By this means the projectile is not only prevented from too violently bearing or frictioning on the bore of the gun, but a highly anti-attrition substance is also provided, to reduce friction and to aid in propelling projectiles from cannon.

The patentee claims, "First,—the employment in breech-loading ordnance of a breech block for closing the breech aperture, constructed substantially in manner described. Secondly,—the improved axle, and parts connected therewith, for operating the opening and closing of the

breech block, substantially as described. Third,—the employment of a bolt or pin for securing the breech block in position, substantially as described. Fourth,—the method or methods, hereinbefore described, of causing the breech block to recede, together with the arrangement or arrangements for preventing the shock caused by the explosion of the charge from acting injuriously on the parts of the gun, substantially in manner described. Fifth,—the employment of covers or aprons for keeping dirt or grit from the surface of the breech block, constructed and acting substantially in manner described. Sixth,—the construction and employment of gas checks, substantially as described. And, Seventh,—the application to, or the employment of, graphite, or of a graphitic composition, to grooves formed on the surface of projectiles, substantially in manner and for the purposes described."

To CHARLES AUGUSTUS FERGUSON, the younger, *and* THOMAS FERGUSON, *of Millwall, for improvements in apparatus for checking the recoil of gun carriages.*—[Dated 8th April, 1864.]

THESE improvements relate to a novel mode of constructing and working duplex compressors.

In Plate VIII., fig. 1 is a back elevation of a gun carriage fitted with the improved duplex compressor; fig. 2 is a plan view of the same; and fig. 3 is a vertical section through the compressors on the line *a*, *b*, fig. 2. *a*, *a*, is the body of the gun carriage; *b*, *b*, the slides; *c*, *c*, two internal slides or ribbons attached thereto; *d*, is the upper, and *e*, the lower compressor plate; *f*, *f*, two longitudinal blocks of wood, with an oval indent in their centres lined with metal; *g*, is a vertical shaft, square in the middle, with a right and left-handed screw at top and bottom; *h*, is an oval metal cam, fitted on the square of the shaft *g*; *i*, is a forked and slotted lever, keyed on the top of the shaft *g*; *k*, is a screw, turning in bearings affixed to the under side of the gun carriage; *l*, is a corresponding screw nut, which traverses backward and forward upon the screw shaft *k*, when it is made to revolve. Upon the top and bottom of the nut *l*, there are projecting horns or lugs, which work in the slots of the lever *i*. *m*, is a wheel and handle for giving motion to the screw shaft *k*. When out of action, the oval cam *h*, has its longer axes fore and aft of the carriage, and the upper and lower compressor plates, as well as the longitudinal blocks, are out of forcible contact with the slides; but, on turning the handle *m*, the revolution of the screw *k*, causes the nut *l*, to traverse from left to right, carrying round the lever *i*, and shaft *g*, which, by means of the left and right-handed screws, draws the two compressor plates *d*, and *e*, together; and at the same time, by moving round the oval cam *h*, forces the longitudinal blocks *f*, *f*, asunder; thus generating such an amount of friction upon the upper, inner, and under surfaces of the slides, as greatly retards the recoil of the carriage when the gun is fired. When the gun is not of very large dimensions, the screw and traversing nut may be dispensed with, and a simple lever worked by a rope, used for giving motion to the compressors, may be employed.

The patentees claim, "the combination and arrangement of com-

pressors which act upon the upper, inner, and under surfaces of the slides, by motion given to a common centre by means of a simple lever, or by a combination of mechanical powers, substantially as described."

To JAMES HOWELL, *of Cock-lane, for improvements in machinery for hammering and planishing metal plates.*—[Dated 9th April, 1864.]

THIS invention consists in hammering metal plates by means of a hammer pressed down on the anvil, and raised after each blow by a spring. The figure in Plate VIII. is a side view of the improved machinery. *a*, is the foundation plate, made to carry the anvil block *b*, the hollow column *d*, and a rod *n*. The anvil *c*, is made to fit the anvil block *b*, and can be removed or adjusted at pleasure. In the column *d*, a metal guide *e*, is fitted, and is allowed to rise or fall; and is maintained at the required position by the set screws *f*, *f*. The bearing *g*, is screwed into the guide *e*, and is also adjusted by the back nut *q*. The cross head *h*, is supported in the bearing *g*. The shaft *k*, of the hammer *j*, is supported in the tube *i*, of the cross head *h*, and is securely fixed therein by the set screws *l*, *l*. The arm *m*, is provided with a slot in the end, through which the rod *n*, passes. The stop *o*, is moveable, being adjusted and fixed by a screw at the required position. The coiled spring *p*, pressing upon the arm *m*, raises the hammer *j*, from the anvil *c*.

To WILLIAM WEILD, *of Manchester, for improvements in the casting of ingots from metal prepared by Bessemer's process.*—[Dated 11th May, 1864.]

HITHERTO, in casting ingots from metal prepared by the method known as "Bessemer's process," the molten metal has been received in a vessel having a valve at its bottom, which is open to allow the metal to pass out directly into the ingot mould, which is placed in a vertical position below it; and when the ingot mould is sufficiently filled, the valve is closed, to prevent any further escape of the metal till the vessel is brought over the next mould to be filled. This system has not been found satisfactory, as there are difficulties in the working of the valve, and in discharging this molten metal directly into the ingot mould, owing to obstructions in the valve orifice; and besides this, the pressure of the molten metal, and the distance it has to fall into the ingot mould, causes the metal to become greatly agitated, and mixed with air to such extent as to make the ingot so cast spongy and defective, so that "flaws" appear in articles afterwards formed of such ingots.

In order to remove the above-mentioned objections, the patentee adopts the following arrangements:—

In Plate VII. is a sectional elevation of a group of, say, six ingot moulds, placed round a central ingot mould, the lower ends of all of which communicate with the central mould by passages or gateways radiating from it. *a*, represents the ground line; *b*, a flue heated by the products of combustion from the waste heat of the furnaces, or from a special furnace: *c*, is a base plate or slab, forming the top of

the flue; and in its upper surface a central conical cavity is formed, having six radiating branches, forming "gateways." These gateways are less at the bottom than at the top, so that the metal left in them after each casting operation may be easily withdrawn from them. The lower slab *c*, is covered by another slab *d*, which is kept central by a ring or lip c^1, round the lower slab *c*, as shown. The upper slab *d*, fits close to the lower one *c*, and covers the gateways c^2, so as to make them close channels, open at each end. The outside end of each channel or gateway communicates by means of a hole d^1, in the slab, with the ingot moulds *e*, placed above; and the inside end of each channel communicates by a hole d^2, in the slab with the central ingot mould *e*. The edge of the upper slab *d*, is toothed for a short extent, and is made to gear with a worm *f*, carried in bearings attached to, or formed upon, the lower slab *c*. This worm can be rotated either way by means of a handle, to which a reversible pawl is jointed, so as to act upon a toothed wheel, fixed on the worm shaft. By giving rotatory motion to the upper slab *d*, the communication between the radiating gateways c^2, and the ingot moulds *e*, can be readily cut off. The central ingot mould is made higher than those surrounding it, so as to give sufficient "head" of molten metal to overcome the resistance to the passage of the molten metal through the gateways. When the casting operation is to be performed, the gateways and ingot moulds are coated with clay wash, in the usual manner, the upper slab *d*, is adjusted over the gateways c^2, and the ingot moulds *e*, are fixed in their places; and assuming that the slabs and ingot moulds are sufficiently heated, the molten metal is brought, by a ladle with a valve in its bottom, over the central ingot mould. The metal is allowed to descend into this mould, when it passes through the bottom, along the gateways c^2, and simultaneously rises in all the ingot moulds, except that it maintains a higher level in the central mould. When the outside moulds are filled, the upper slab *d*, is moved by means of the screw or worm *f*, and this simultaneously cuts or separates the molten metal in the outside holes d^1, in the upper slab *d*, from their gateways in the lower slab *c*; so that when cooled, the ingot and its mould can be readily removed, as the metal passing through the slab *d*, will easily withdraw, being coned with the larger end towards the ingot. The central ingot is broken away after it has cooled a little, then the upper slab *d*, is lifted by a suitable crane, and the metal in the gateways c^2, is removed; the gateways receive another wash of clay; the upper slab *d*, is replaced and adjusted, when another series of ingots may be cast, and so on.

The patentee claims, "the system or mode of casting ingots of metal (prepared by the method known as Bessemer's process), as hereinbefore described; also the formation of gateways in metal slabs, the heating of such slabs by flues, and the separation of the molten metal in the ingot moulds from that in the gateways, by sliding the upper slab in casting ingots of metal, substantially as hereinbefore described."

To William Edward Gedge, *of Wellington-street, Strand, for improved apparatus for sifting or sorting cereals,—being a communication.*—[Dated 16th April, 1864.]

The figure in Plate VII. shows, in sectional elevation, the improved apparatus for sorting cereals. 1, is the hopper, which receives the grain to be sifted, and has the end of the spout of the hopper suspended at M; 2, is a fan or ventilator, blowing away the light bodies during the fall of the grain; 3, first tray of the sifter, made of sheet iron, cut out so as to permit the small seeds to escape on to a double bottom of sheet iron without cuts or holes; 4, second tray, inclined in an opposite direction to the first, also of sheet iron, but with larger cuts or holes, and furnished with a double bottom like the first; A, A, openings, which throw aside the siftings received by the double bottoms; 5, third tray, inclined in a direction opposed to that of the second, and parallel to that of the first tray, also of sheet iron, and cut with round and elongated holes, larger than the preceding. The siftings of this last tray fall on the floor, so that the corn which escapes from the hopper slides successively on each of the three inclined trays, and comes out at the bottom freed from bad seeds and small grain. This improved sifter, which consists of three trays tied by two diagonal cross pieces, suspended to four springs, is set in motion by a connecting rod. O, is a horizontal shaft, provided with a crank, to set in motion the fan and the sifter by small toothed gearing. The bodies larger than the corn are retained, and slide on the small grating, which serves as a bottom to the spout of the hopper, to be thrown out at the back of the instrument. S, is a point, fixed on the first tray, and acting on the spout of the hopper, which it keeps in motion, thereby causing the grain to fall into the apparatus.

To Henry Higgins, *of Salford, for improvements in machinery or apparatus for cleaning cotton from seeds, and for carding such material.*—[Dated 14th April, 1864.]

This invention relates, firstly, to that machine for cleaning cotton from seeds known as the Macarthy gin, and shown in Plate VII. at figs. 1 and 2. *a*, is the driving shaft, carrying a disc *b*, provided with a crank pin *c*, which actuates a connecting rod *d*. This rod is jointed at *e*, to two levers *f*, *g*, the latter of which turns at its lower end upon a fixed centre *h*, and the former, at its upper end, is connected to a short lever *i*, capable of vibrating loosely upon a shaft *k*. The lever *i*, is formed upon a boss *l*, provided with one half *m*, of a clutch box, the other half *n*, of which is mounted upon the shaft *k*, with a groove and feather, so as to turn that shaft when caused to vibrate. The usual vibrating blade is shown at *o*, carried by arms, which are formed upon the shaft *k*; and these arms also support the grid *p*, through which the detached seeds fall. It therefore follows that the blade *o*, and grid *p*, vibrate together during the operation of the machine. The fixed blade is at *q*, carried as usual by a stationary part of the framing, but which is not shown; and the roller is at *r*, driven by gearing from the shaft *a*. In contact with the half *n*, of the clutch box is one end

of a lever *s*, turning upon a fixed centre at *t*, and continually pressed towards the said clutch by a spring *u*. This lever *s*, is furnished with an arm *v*, turned upward, and extending into a slot formed in the rod *w*, which, at its other end, is provided with a fork, embracing the driving strap. On motion being communicated to the driving strap on a pulley on the shaft *a*, the crank pin *c*, will force the connecting rod *d*, to and fro, and will thus, by acting on the toggle-joint levers *f*, *g*, cause the lever *i*, to vibrate; and this lever, being connected to the shaft *k*, through the medium of the clutch box *m*, *n*, will impart the required motion to the reciprocating blade *o*. Should, however, any undue obstruction to the action of the machine take place, then the half *m*, of the clutch will force back the other half *n*, against the resistance of the spring *u*, and in so doing will cause the lever *s*, to turn upon its centre, and carry forward the rod *w*, which, by means of the fork thereon, will shift the driving shaft on to the loose pulley. By the employment of the toggle joints *f*, and *g*, and connecting rod *d*, the joint *e*, is caused by the crank pin *c*, to pass to and fro on each side of the centre line, and there will therefore be two vibrations of the lever *i*, and blade *o*, for each revolution of the shaft *a*. It will be observed, that the relative positions of the fixed and reciprocating blades, and the moveable grid, form a trough or hopper, and the material being thrown into this, falls, by reason of the disposition of parts shown, into a favourable situation for being immediately operated upon.

The second part of the invention is shown at fig. 3, in which *a*, is a roller of a carding engine, the clothing *b*, of which, as usual, does not extend to the ends of the said roller. At *c*, is a disc, provided with a boss, through which the axle of the roller passes, and this boss is made fast to the framework, so as to render the disc *c*, stationary. Extending from the disc *c*, is an annular flange *d*, surrounding the roller *a*, and extending inward to the termination of the card clothing. As the roller *a*, revolves, the flange *d*, remains stationary, and forms a shield, for preventing the material under operation from passing off endways.

The patentee claims, "Firstly,—as applied to Macarthy gins, the employment of the toggle joints *f*, *g*, for causing the reciprocating motion of the blade; also driving the said blade, through the medium of two parts, held together by a spring, or other such yielding power, capable, when separated, of arresting the motion of the machine; also the relative dispositions shown of the fixed and reciprocating blades and vibrating grid. Secondly,—as applied to the rollers of carding engines, the use of annular flanges, for the purpose above set forth."

To DAVID NEVIN *and* WILLIAM COPPIN, *both of Londonderry, Ireland, for improvements in machinery for clearing and separating the woody parts from the fibrous portions of flax, hemp, and other like material.*—[Dated 3rd May, 1864.]

THIS invention consists, firstly, in gearing and driving the feed rollers in such a manner that the rollers may be caused either to revolve in

such a direction as to feed the fibre forwards, to be acted on by the beaters, or may, at the will of the workman, be caused to revolve in the opposite direction to move back the fibre; and when the rollers are revolving in a direction to feed the fibres forward, the rollers are caused to revolve at a slower speed than when revolving in the opposite direction, to move back the fibres.

The invention also consists in covering one of the feed rollers with an elastic material, by which means the whole of the layer of fibres will be held between the rollers, even though the layer be of uneven thickness. The beaters for acting on the fibres are, according to this invention, formed in such manner that, when one of the beaters on one of the shafts or axles is acting on the fibrous materials, such materials may rest against a curved plate carried by the other beater axle; so that the fibrous material is prevented from getting away from the beater, which is for the time acting upon it by means of the curved plate or guard.

The figure in Plate VIII. is a side view of the improved machine. *a*, *a*, is the framing of the machine; *b*, b^1, are two rotating axles, carrying the beaters. In this arrangement, three feed rollers *c*, *d*, and *e*, are employed, which feed forward and retain the layers of fibre to be acted on by the beaters; but two or other number of feed rollers may be employed in place thereof. The roller *c*, is covered with elastic material, vulcanized india-rubber being, by preference, used for this purpose; or, in place of the roller *c*, being covered with elastic material, either or both of the other rollers may be so coated. The thickness or depth of the elastic coating should be about ½ to ¾ inches; so that even though any of the layers of fibre should vary very considerably in thickness, yet each part of the layers of fibre would be securely held by the rollers. The thickness of elastic coating may be obtained by employing a single tube of vulcanized india-rubber mounted on a suitable roller or core; or the roller or core may be covered with a number of rings of india-rubber, placed side by side. The rollers *d*, and *e*, are formed with longitudinal serrations, in order to hold the flax more securely. The roller *c*, has motion imparted to it in the following manner:—On the axle of the roller are two bevil wheels *f*, and *g*; the former gears with a bevil wheel *h*, and the latter with a wheel *i*, which wheels are carried by the upright shaft *k*, and are both free to turn around this shaft: either one or other of these wheels can, however, be made fast on the shaft by means of the the sliding clutch *l*, worked by the lever l^1. The wheel *h*, is of smaller diameter than the wheel *i*, and, therefore, the wheel *h*, is made fast with its axle *k*, when it is desired to feed a layer of fibre inwards to be acted on by the beaters. When the layer of fibres is to be withdrawn from being acted on by the beaters, the wheel *i*, is made fast on the shaft, and the roller *c*, is caused to revolve in the opposite direction and at a greater speed.

The construction of the beaters carried by the axles *b*, b^1, is seen in the drawing. Each beater axle carries two blades *m*, *m*, and two curved plates or guards *n*, *n*. The beater axles are geared together in such manner that when one of the blades *m*, on one of the beater axles comes round to act on the projecting end of the layer of fibres held between the rollers, one of the curved guards *n*, on the other beater axle, will have come round into such a position as to prevent the fibres being

thrown upwards by the blade *m*, and so escape being acted on by the beater. The curved guards, at their front edges, that come in contact with the fibrous material held by the rollers, are, by preference, serrated; the acting edge of the blades *m*, and also the edges o^1, are likewise, by preference, serrated. The serrated plate o^1, is secured in its place by bolts.

In working the machine, a layer of flax or other fibre is spread on the table *p*; the clutch *l*, is then moved by the lever handle l^1, in such a manner as to cause the wheel *h*, to be made fast on its axle, and so cause the feed rollers to revolve in a direction to draw the layer of fibre inwards towards the beaters. The layer of fibre on the table *p*, is then moved forward by hand, so as to cause the feed rollers to seize hold of the forward end of the fibres; the rollers then gradually feed forward the layer of fibre, until about half of its length has been acted on by the beaters; the rollers are then, by moving the clutch handle, caused to revolve in the opposite direction, and so move back the layer of fibre, and deposit it on the table *p*. The layer of fibre is next, by the workman, turned end for end, and the feed rollers are again caused to revolve in such a direction as to feed the fibres forward, to be again acted on by the beaters. After this the fibres are again drawn back on to the table *p*, by causing the rollers to revolve in the contrary direction; and the layer of fibre is then removed from the table, and a fresh layer placed upon it, to be treated in a similar manner to that above described.

To SHAKESPEAR SHAW *and* HENRY FISHWICK, *both of Manchester, for certain improvements in apparatus for stamping and embossing textile fabrics.*—[Dated 3rd May, 1864.]

THE ordinary stamping process employed for printing patterns or trade marks upon calico and other fabrics consists in the use of a stamp or die, which is held by the workman, who first dips it in a solution or powder of indigo or other colour, after which he stamps it upon the fabric, leaving only an imperfect impression, and often transferring a portion of colour to the layer of calico immediately underneath.

The apparatus for stamping or marking piece goods, forming the subject of this invention, is shown in side elevation at fig. 1, Plate VIII., and in front view at fig. 2. *a, a*, is the framing of the apparatus, in which the fulcrum of the lever *b*, is supported; *c*, is the stamp bearing the name, trade mark, or design with which the piece is to be impressed, such stamp being secured by nut and screw to the vertical sliding bar *d*, which is connected to the lever *b*, by the link *e*. The carriage *f*, runs upon wheels beneath the stamp, and carries an ordinary printer's inking roller *g*, so that as the roller passes beneath the stamp, it becomes inked; and after the roller has passed, if the handle of the lever be brought down, the stamp will descend and mark the piece of goods at any part required between the inking roller and the end of the carriage.

The patentee claims, "the application and use of a self-inking stamp for marking or stamping certain descriptions of fabrics made up as "pieces," and called "piece goods;" and also the combination of mechanism for effecting the said object, as described."

To Edwin Heywood, *of Hill House, Yorkshire, for improvements in means for holding fabrics in stretching and finishing apparatus, which improvements are also applicable to otherwise holding fabrics distended.*—[Dated 7th May, 1864.]

This invention relates to means for effecting the holding of fabrics at the selvages, so that the fabric may be progressively taken hold of and released in its traverse under operation.

In Plate VII., fig. 1 shows, in section, parts of one end of a stretching and finishing apparatus, arranged according to this invention. The apparatus is fitted with a series of nippers *a*, *a*, *a*, each of which is formed with a pair of jaws 1, 2. The jaw 1, is capable of turning upon the axis of motion 3, carried by the standard 4, formed on the part to which the lower jaw 2, is fixed. The nippers are formed at their upper and lower ends 5, 5, to pass into grooves or recesses b^1, formed in the stationary frames *b*, *b*; and they have motion given to them in these grooves by means of wheels *c*, the teeth of which embrace the bodies of them between the parts 5, 5, and in their rotation give motion to the series, by pushing them along the grooves b^1. During their motion in these grooves, the nippers are kept in correct position in relation to each other by the shape of their end pieces 5, 5, corresponding with that of the grooves b^1. The wheels *c*, are affixed to shafts c^2, supported by suitable bearings, and receive motion from steam or other power. The position of the fabric, as held between the nipping surfaces 1, 2, is indicated by the dotted line in fig. 1; and it will be seen that each of the moveable jaws 1, is formed with an elongated tail 6, the weight of which is to give the necessary tendency to its closing on the other nipping surface or jaw. Just in advance of the point where the fabric is to be taken hold of by these nipping surfaces, a bar *d*, with an inclined surface, comes under the tails 6, opening the jaws 1, in succession, as indicated by dotted lines. The axis 4, or line of motion of this moving jaw, is situated, as shown, opposite or nearly vertical to the line of grip at the point of contact of the nipping surfaces; and the inclination of the stationary jaw 2, is tangential to a point in a circle struck from the axis of the moving jaw and passing through the point of grip; whereby the holding effect is in proportion to the pull exerted by the fabric held. Fig. 3 shows a modification in which several nipping surfaces 1, are applied to the same surface 2, and with a variation in the form of the tail piece. Pairs of jaws, similarly arranged, are otherwise applicable to holding fabrics distended. When formed with a thumbscrew, or other means of attachment, they may be used by ladies in holding their work.

The patentees claim, "the application to apparatus for stretching and finishing, and otherwise holding, fabrics, of nipping surfaces, arranged and operating in manner substantially as explained."

To William Giles Cooper *and* James Fletcher, *both of Burnley, Lancashire, for improvements in looms for weaving.*—[Dated 20th April, 1864.]

This invention consists in an improved mode or arrangement for

weighting the yarn beam of the loom, for the purpose of regulating the weighting or tension of the yarn.

In Plate VIII., fig. 1 is a back view of part of a loom, having a yarn beam, provided with the improved weighting motion; and fig. 2 is a transverse section of the same. *a*, represents the end frames of the loom; *b*, the back cross rail; *c*, the yarn beam; and *d*, *e*, the chains or ropes which encircle it. To one of the end frames *a*, is fixed a bracket *f*, having a stud, on which is jointed the short lever *g*, carrying a weight *h*. One end of the chain or rope *d*, is connected to the short lever, as at *k*, and the other end of the chain to the balance or equilibrium lever *l*, which works on a stud or fulcrum in the middle of the cross rail *b*, and is also connected to the chain *e*, the other end of which is connected to the coiled spring *m*.

The advantages to be obtained by the use of the improved weighting motion are said to be great facility in weighting the yarn in the loom, the weight being moved with ease from one place to another,—it weighing little more than half the ordinary weight for heavy cloth, and less than half for light cloth. There is an equality of weight or resistance at each end of the yarn beam, which ensures the certainty of making even cloth in all positions of the weight on the short lever. The loom is worked more easily than in the old plan, on account of there not being so much dead weight to work against.

The patentees claim, "the balance or equilibrium lever *l*, connected to the chains or ropes which encircle the yarn beam, and working in connection with the weighted lever *g*, and spring *m*, as all such improvements are herein described and illustrated."

To JOHN DODGEON, *of Burnley, Lancashire,* JOHN GAUKROGER, *of Hebden Bridge, Yorkshire, and* WILLIAM SHACKLETON, *of Todmorden, Lancashire, for improvements in looms for weaving.*—[Dated 12th May, 1864.]

THIS invention relates to the letting-off or weighting motion in looms for weaving, and the improvements consist in the application of a friction plate or pulley to each end of the warp beam, in addition to the ordinary ruffles or hoops which are now employed. These friction plates are supported in straps or chains suspended to the loom end frames, and the beam is supported in the plates. A catch is hinged on each of the plates, which takes into a ratchet wheel fixed on each end of the beam, which may be either in or out of gear, so as to connect or disconnect the beam and the plates, as may be required. By this means more or less friction can be applied to the warp beam, or the letting-off motion can be regulated according to the different kinds of fabrics being woven.

In Plate VII., fig. 1 is part of an end elevation of an ordinary loom, with the improvements applied thereto, and fig. 2 is a back elevation of the same. *a*, is the warp beam, with flanges *b*, and ruffles or hoops b^1, such as are in ordinary use. *c*, are ratchet wheels, fixed to the ruffles, or otherwise to the beam; *d*, are the friction plates or pulleys, which are supported in the straps or belts *e*, suspended on the pins *f*, fixed to the loom end frames. The ends of the beam pass through and rest or

have their bearings in the centres of the friction plates or pulleys, instead of bearing in the loom end frames as heretofore. A pawl *g*, is hinged on the side of each of the plates *d*, which, by the pressure of springs *h*, are held in the notches of the ratchets *c*, when required. These catches may be held out of contact with the notches of the ratchets by means of a spring pin *i*, passed through each catch into a hole in the plate or pulley. *j*, are ordinary weighted levers, with friction cords *k*, attached thereto, and passing around the ruffles or hoops of the beam, and attached to spring bars *l*. The whole weight of the beam, with the warp and the weighted levers, rests or is supported in and by the straps. The friction plates are loose on the ends of the beam, but are temporarily connected therewith by the catches; so that, as the beam is caused to rotate by the action or unwinding therefrom of the warp during the progress of the weaving, the plates are also carried around thereby, and have to slip in the straps or belts; whereby friction is applied to retard the rotation of the beam, in addition to the ordinary friction of cords and weighted levers. The weights *m*, are considerably reduced in size.

It will be readily seen that, as the beam is only connected to the friction plates by the catches, it is at liberty to oscillate freely with the opening and closing of the shed; and is also at liberty to be turned back when required, without turning the friction plates backward. When the beam is full of warp, it will be of the greatest weight, and, consequently, the greatest amount of friction will be applied to retard rotation of the beam by the straps or belts which support it; and this is at the time when the leverage of the warp on the beam is greatest to overcome friction. As the warp is gradually reduced or taken off the beam by the process of weaving, the leverage becomes less, and so does the weight of the beam; consequently the friction will also be decreased in like manner, thereby avoiding the frequent adjustment of the weights on the levers.

The patentees remark that, in the weaving of some kinds or descriptions of fabrics, ordinary yarn beams may be suspended in straps or chains passing around or under the ruffles or hoops, instead of the beam axle bearing in the loom frames, as at present; but, in such case, the advantages of free oscillation of the beam at the opening and closing of the shed, also the easy turning back of the beam when required, would be lost; they, therefore, prefer to employ ratchet wheels and catches, or a mechanical equivalent, to effect these desirable objects.

To GEORGE PULSFORD, *of Saint Pierre les Calais, France, and* GEORGE WALKLAND, *of the same place, for improvements in means or apparatus employed in the manufacture of lace by lace machinery; which improvements are also applicable in the manufacture of other weavings.*—[Dated 9th May, 1864.]

THE object of this invention is to admit of variations in the gauge or width of the fabric during manufacture in lace machinery. For this purpose, in place of the short and comparatively stiff taking-up points now used, thin blades or points are employed, of length and flexibility which will admit of their being readily set and held at a different gauge

at their outer or opening ends from where they are set in their leads or other holding means. Each of these points is passed between blades or divisions of combs, which, at the parts where variation in the gauge of the fabric is required, are inclined; so that, at such parts, these blades or combs are at one of their ends set closer together than at the opposite ends thereof, in order that any movement of them in relation to the points will, at such parts, effect variation of the gauging of the points at their outer or operating ends. The variation of the gauging of the points is effected, during the working, by means of jacquard or other pattern surface, aided by springs or weights acting on the bar or bars carrying these combs, to cause them to slide upwards or downwards, or it may be endwise, on the points, or to control these combs whilst the points move within them.

In Plate VII., fig. 1 shows a section of an ordinary lace machine, with adaptations thereto according to this invention. Figs. 2, 3, and 4, show some of the parts separately. *a*, shows a bobbin and carriage; *b*, *b*, the catch bars for operating the series of bobbins and carriages in the ordinary manner for the work to be produced; *c*, is the work bar; c^1, the work roller; *d*, *d*, are the taking-up points, which, according to these improvements, are formed by thin blades, so as to possess the desired amount of flexibility in the direction towards each other of the points of each lead; and they are set in the ordinary manner in leads d^1, d^1, carried by the bars d^2, which are suspended by the arms d^3, d^3, from shafts d^4; and the shafts d^4, are, by arms d^5, d^5, supported from the shafts d^6, d^6, which are, by other arms affixed thereto, operated from suitable cam or pattern surfaces for the entering and taking-up motions, as is well understood. Each of the blades or points *d*, *d*, passes through a division formed between the blades or divisions of combs *e*; and the blades or divisions of each of these combs *e*, where variation in the gauge of the fabric is required, are inclined—as shown by a separate view of one of them at fig. 4; so that, at such parts, these blades or combs are, at one of their ends e^1, set closer together than at their opposite ends e^2, thereof, in order that a movement of them on the points *d*, may effect variation in the gauge of the points at their operating ends. The blades or combs *e*, are set in leads e^3, e^4; and the leads e^3, are, by screws, affixed to bars e^5, which are affixed to the arms e^6. These arms are suspended from arms e^7, from the bars or shafts e^8, which are each acted upon by springs, or by other suitable means, with a tendency to keep the combs *e*, raised; and they are operated for the descending motion by means of pattern segments e^9, (one of which is shown separately at fig. 5), acting on the arms e^7. There are several of such segments across the width of the machine, each of which turns upon an axis e^{10}; and they are connected together, and to jacquard or other pattern surface, by means of links e^{11}, so as to bring them into the desired relative position. These pattern surfaces e^9, act on one set of arms e^7, through the intervention of the sliding pieces *f*, *f*, which are capable of sliding freely in the guides f^1, f^1. Other of the pattern surfaces e^9, act on projections e^{12}, applied to their arms e^7. The lower ends of the arms e^6, are guided to move to and fro with the bars d^2, by their passing through the guides *g*, affixed to the bars d^2.

Figs. 6 and 7 show modifications of the leads of instruments *e*, but

these may be varied. Supposing the effects desired to be obtained on the fabric are to be by contraction, then, in the working of the parts, the points of the blades *d*, will take in between the threads near the tops of the bobbin carriages at their full or widest gauge, and in the ascending motion of the points to take up, the combs *e*, will be moved on them at the parts desired, with a tendency to contract and reduce the gauge of the points at their outer ends, and, consequently, of the threads acted upon to the extent desired; and this variation of gauge may be varied at each action of the points, according to the figure desired to be obtained to the fabric. When, even at these parts, there is no necessity for variation in the gauge of the points, the combs acting on or with them will simply move with, but without moving on them. In like manner, the gauge of the fabric may be extended, provided space is left at the parts for such extension of the points. This method of effecting variations in the gauge of the points of lace machinery is also, in like manner, applicable to effecting variations in the gauge of the sley or reed carried by the batten of looms used in weaving other fabrics.

In carrying out this application of the improvements, the bars or plates of the reed are, at the parts of it desired, capable of moving sideways at one or both of their ends; and at such end or ends they are held in position by a comb similar to the combs *e*, already referred to, and moveable in the reed frame, to admit of variations in the gauge of the reed; and such movement to the comb is effected by suitable pattern surface.

The patentees claim, "the application in machinery for the manufacture of lace of taking-up points capable of being actuated, and the application of actuating means to taking-up points, in order to admit of variation being obtained in the gauge or width of fabric being produced, substantially as explained; and, secondly, the application of means to effect variations in the gauge of the reed of looms used in weaving other fabrics."

To BARTHOLOMEW GYTE *and* MARTIN WALSH, *both of Edale, Derbyshire, for improvements in machines for twisting and doubling yarn and thread.*—[Dated 14th May, 1864.]

THIS invention is applicable to the ordinary throstle doubling machines, and consists—first, in an improved mode of supporting the top roller, in order that, when the yarn or thread breaks or snarls, the top roller may be taken out of contact with the bottom roller, to prevent waste; secondly, in placing between the rollers and the spindles a wire, furnished with bristles or other suitable substance, between which the yarn or thread passes, and by which, when it breaks, it is prevented from becoming entangled in the yarns or threads of the other spindles.

The figure in Plate VII. is an elevation, partly in section, of part of an ordinary throstle doubling frame, to which the improvements are applied. *a*, is the trough; *b*, the rail supporting the guide pegs *c*; *d*, is the cap bar; *e*, the bottom roller; and *f*, the top roller; *g*, is the guide rod above the spindles *h*, to which the flyers *i*, are fixed; and *j*, are the bobbins on which the doubled yarn or thread is wound.

The first part of the invention consists in supporting the top rollers *f*, in the swing frames *k*, which swivel on knife-edge centres in the slots in the cap bar *d*; the yarn, after passing between the top and bottom rollers, passes over the front of the swing frame *k*, and the tension of the yarn between the spindles and the rollers holds the swing frame in the position shown by the full lines, the stop wire *l*, pressing against the end of the cap bar, preventing the front of the swing frame from coming in contact with the bottom roller *e*. When the yarn breaks, or snarls are produced above the spindle point, the swing frame swivels partly round, owing to the preponderating weight being to the left hand of the fulcrum, and the top roller slides back, as shown by dotted lines, or out of contact with the bottom roller—thus preventing any more yarn from being drawn forward, and avoiding the waste which would be occasioned by the yarn lapping around the bottom roller. As soon as the broken end has been pieced, or the snarls have been removed, the swing frame resumes its original position, and the top roller drops again into its bearings, and in contact with the bottom roller; after which the operations proceed as before.

m, is a small circular brush, extending the whole length of the frame, and placed in any convenient position between the tops of the spindles *h*, and the roller *e*. The brush is composed, by preference, by securing bristles between twisted wires; and the yarns, in passing from the rollers to the guide rod *g*, enter between the bristles; consequently, when an end breaks, it is held by the bristles and prevented from entangling with the yarns of the other spindles.

The patentees claim, "First,—supporting the top rollers of twisting and doubling machines in swing frames, in the manner and for the purposes described; and, Secondly,—the application of the circular brush *m*, or other equivalent, to twisting and doubling machines, for the purpose described."

To ORRIN CLARK BURDICT, *of Newhaven, Connecticut, U.S.A., for improvements in manufacturing nuts, and the preparation of the metal therefor, and in the machinery or apparatus employed therein.*—[Dated 30th April, 1864.]

THIS invention relates, first, to improvements in nut-making machines; and, secondly, to improvements in swaging machines.

In Plate VII., fig. 1 is a plan of a nut-making machine with the improvements applied thereto, and figs. 2 and 3 are sections of parts of the same; fig. 4 is a front view, and fig. 5 a cross section, showing improvements in swaging machines; and figs. 6 and 7 are detached views of parts of the same.

Nut-making Machines.—On a bed plate A, fig. 1, is placed a driving shaft B, supported in bearings C, and driven through the application of power to a pulley D; the bed plate also carries a slide E, which moves freely in guides F, and is operated by the cam G, on the shaft B, bearing against a roller H, on the slide. The slide is drawn back by the action of another cam I, bearing against the roller J, which is attached to the slide E, by means of a projection K. At the other end of the slide there is a punch L, of the form and size of the nut to be made,

which punch is firmly fixed in and moves with the slide E. Fixed to, or forming part of, the bed plate, is a block M, in which is placed a die made in two parts *a*, *b*, fig. 2; the part *a*, being made concave on its inner surface, and the part *b*, convex, to set in it and fit the concavity in the first part *a*. The part *b*, which is convex, is made with a hole *c*, of the size and form required for any nut to be made, and must correspond to the size and form of the punch L, on the slide E; and the concavity in the part *a*, is for the purpose of curving the face of the nut. In connection with the block there is a cutter *d*, fig. 1, against which the blanks are cut from the heated bar to form the nuts; and secured to the block P, there is a fixed punch N, placed centrally through the die, and of the diameter required for the hole in the nut. A central hole *n*, fig. 3, is made through the punch L, on the slide E, of the size of the stationary punch N, through which hole the punchings of the nut pass, and thence out through the conductor *o*. The stationary punch is surrounded by a sleeve or tube *i*, and fitted to move freely thereon and through the die, and is employed to support the blank in its proper position while being cut from the bar, and also to throw out the nut for its swage.

To operate the machine, power is applied to drive the shaft B, and a bar of iron, properly heated, is placed before the die and against the cutter. The sleeve *i*, must extend out to the cutter, so that the end of the bar to be cut off will rest on the sleeve, and the said sleeve is held firmly in that position by the action of the cam R, on the shaft B, transmitted to a lever *h*, through a crank lever and connecting rod. The slide E, and punch L, now move forward by the action of the cam G, and as soon as the punch L, reaches the bar and begins to press upon it, the sleeve *i*, which was in the position shown by the dotted lines, fig. 2, retreats as fast as the punch advances. This result is accomplished by making the action of the cams, G, and R, simultaneous. By this operation the blank being cut from the bar is sustained and firmly held between the sliding punch L, and sleeve *i*. After the blank is cut from the bar, and whilst it is still held as aforesaid, it is carried into the die *a*, against the stationary punch N, which punches the eye of the nut, and thence the blank is carried into the bottom of the die. Here the sleeve rests, and the sliding punch L, swages the nut to the form of the die. The instant this is done, the punch L, retreats, by the action of the cam J, as before described. At the same time, the sleeve advances, by a corresponding action of the cam R, and forces the finished nut from the die. A second nut is cut, punched, and swaged in like manner, and so on. The advantages of this machine over other "nut machines" are, first:—By making the die in two parts, as described, the part *a*, serves for many sizes of nuts, time being only required to change the part *b*, for each different size or form of nut, that is, to a certain extent. This part *b*, is formed round, and it has simply a hole of the required form and size entirely through it; and for different sizes and forms the moveable part *b*, of the die is changed, and corresponding punches are inserted. Another great advantage in the operation of the sleeve *i*, is that it holds the blank and prevents it from turning, and insures its entrance squarely into the die.

Swaging Machine.—In nut machines, as well as in all swaging machines where dies are used, the trouble and expense of repairing

dies detracts materially from the practical usefulness of such machines. To overcome in a great degree this trouble and expense is the object of this part of the invention. It consists in forming a die of four separate pieces, each piece in its breadth and depth equal to the nut or piece to be swaged, and in length about three times its width, or more or less. These pieces or blocks are so placed that each will form one of the four sides of a die, and when the outer angle, or corner, or face of the die shall have become worn by use, the block may be shifted to present a new face or angle. Each end of each block allows of three such changes, and the sides an equal number, and thereby no repairing is required until all the angles have become worn. Thus, in the die holder A, figs. 4 and 5, four pieces or blocks of steel B, C, D, E, are placed, each of the same width and depth as the nut or piece to be swaged, and about three times as long; and one of the blocks is shown in perspective in fig. 6. All the angles on the block are made right angles, and each block is tempered according to the purpose for which it is to be used. The four blocks are placed in the die holder, as seen in fig. 4, the upper and lower blocks B, D, being set so that the parts used in the die will be one side of the centre, and the side blocks are fixed and adjusted in the die holder A, by means of set screws *a*, *b*, *c*, *d*. To form the back or bottom of the die, a block F, of metal is placed in the die holder; and if it is desired to make a curved head, a projection is made from the block, as shown in figs. 5 and 7, the size of the die, and made the reverse of the form required for the nut or piece to be swaged. *e*, represents a punch, and *f*, a sleeve or tube similar to that described in the first part of the invention, and shown in figs. 1 and 2. When the first four angles 1, 2, 3, 4, (fig. 4) have become worn or injured, the four blocks may be turned one quarter over, presenting new angles. In fig. 6, 1, represents the first angle or face used; 5, the second; 6, the third; 7, the fourth; 8, the fifth; 9, the sixth; 10, the seventh; 11, the eighth; these angles being used in the position of C, E, fig. 4. In the position of B, D, 4, is the first angle (see fig. 6); 12, the third; and 14, the fourth. When these angles have been used, the upper and lower blocks are moved to the right or left, as the case may be (see fig. 4); this will present a new fifth angle of surface, and 16, 17, and 18, are the sixth, seventh, and eighth angles; and when these eight angles or bases of the blocks in the position of B, D, are worn, the C, E, is inserted in the place of B, D, and *vice versâ*. Thus, each block is capable of being placed and used in sixteen different positions before any repairs will be necessary; whereas a solid die would require to be faced sixteen times for the same amount of work performed.

The patentee claims, "the employment of a die formed of two parts, as described, and using this die in combination with a moveable punch, a fixed punch, and also a sleeve or tube. And, in swaging machines, the employment of a die composed of four pieces or blocks of steel, as described."

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

February 7th, 1865.

JOHN FOWLER, Esq., Vice-President, in the Chair.

The paper read was, "*The Chey-Air Bridge, Madras Railway,*" by Mr. E. Johnston, M. Inst. C.E.

The author remarked, that the River Chey-Air presented the usual features met with in nearly all the large rivers of Southern India. The banks were generally low and ill-defined, and the bed, for almost the entire width, and to an unknown depth, consisted of clean, sharp sand. For nine months during the year the bed was perfectly dry, being subject only to heavy floods in the months of May, June, and November; but, even during the driest seasons, the substratum was always charged with water to within 2 or 3 feet of the surface.

The bridge was situated on the North-West line, at a distance of 143 miles from Madras; the extreme width of the river at the point of crossing was 3,360 feet, the drainage area being about 2,272 square miles, and the fall of the stream at the rate of 11 feet per mile. At a distance of 20 chains above the bridge the river separated into two distinct channels,—that on the south being 1600 feet in width, and that on the north 1,256 feet in width, and at the point of crossing the bank dividing the two was 464 feet in width. The highest point of this bank was 5·57 feet above the bed of the river, and 2·27 feet higher than the general level of the land for some distance on each side of the river. As it was ascertained that the highest known flood only covered the bank to a depth of 14 inches, it was determined to make this portion of the work a solid embankment, and to span the two arms of the river by distinct bridges; that on the south contained 22 openings, while that on the north had 16 openings, each 70 feet span from centre to centre of the piers.

The piers were built of masonry, laid on timber platforms, placed within dams, at a depth of 15 feet below the bed of the river, the superstructure being composed of ordinary boiler-plate girders. In commencing the operations, the sand over the site of the intended dam was first removed, until the water was reached. The dimensions of the dam, 52 feet by 22 feet, being then set out, piles, 9 inches square, were driven at intervals of 10 feet, to a depth of 18 feet, the heads being cut off level with the water. The piles were secured by waling-pieces, and were strongly braced across. Close planking, 2½ inches in thickness, was next let down behind the piles, and the space around the dam was backed up with clay and grass sods, to prevent the sand from slipping in. The Picottah pumps were afterwards fixed at intervals of 3 feet along the three sides of the dams, being supported on sleepers, bedded on clay,—one end of each sleeper resting on the waling-pieces. Each dam was surrounded by a wooden

trough, for receiving the water raised from the foundation pit; and this trough communicated with a channel, cut to a depth of about 5 feet at the commencement, and terminating on the surface at a distance of 50 chains down the river. This was rendered possible by the fall of the river, 11 feet per mile, and the lift was thus reduced from 15 feet to 10 feet. The Picottah pump was much used in many parts of Southern India for irrigation purposes, and it had been found very efficient for emptying foundation pits. It consisted simply of a balance lever, one end of which was weighted, by a man walking up and down the lever, while to the other end a bucket was suspended by a long bamboo, another man standing on a staging in the dam, guiding the bucket, and filling and emptying it. The bucket was made of thin sheet iron, and was capable of containing about 5 gallons. Two well-trained men would raise, on an average, about 35 gallons per minute, where the lift did not exceed 9 or 10 feet. At the Chey-Air bridge, it was found necessary to use at each dam 36 of these pumps, worked by a gang of 72 coolies, who were relieved every six hours, and who raised, on an average, 1260 gallons per minute,—the mean lift being from 7 to 8 feet.

The timber platforms were of aucha and eloopay, both close, hard-grained woods; and, being entirely protected from the alternate action of air and water, it was believed they would be very durable. These platforms were 42 feet in length by 13 feet in width; the main beams and transverse pieces were 12 inches square, and over these there was a flooring of sleepers, 10 feet long and 10 inches by 6 inches in section. On this flooring heavy courses of well-bedded, hard, slaty magnesian limestone, the blocks varying in size from ½ to ¾ of a cubic yard, were built in hydraulic mortar, and well grouted up to within 18 inches of the bed of the river, and therefore about 18 inches above the lowest level to which the water subsided in the sand. Above this point, the masonry consisted of a light-coloured magnesian limestone, obtained from a quarry situated 2½ miles from the work, and which was delivered at the bridge, by a native contractor, at the rate of 5*s.* 6*d.* per cubic yard, subject to a deduction of one-seventh for bad stacking. No appreciable settlement was noticed after the first course of masonry was laid. The piling and the timber around the dams had, in every instance, remained undisturbed; and the space between them and the masonry had been filled in with waste stone to a depth of 9 feet. The works had withstood the monsoons during three years, without showing the slightest indication of any scour: in fact, after heavy floods, no alteration took place in the bed of the river.

The total cost of preparing a single dam, with timber platform complete, ready to receive the masonry, was

Pile driving	£24	3	6
Excavation	38	13	0
Pumping	50	2	0
Timber platform	37	9	0
	£150	7	6

The bridge contained 16,320 cubic yards of masonry, executed at a

cost of £18,681. The works were commenced on the 18th August, 1860, and were completed, ready to receive the girders, on the 16th January, 1862.

Respecting the character of the work yet remaining to be done, it was stated that it would be merely a repetition of what had already been executed in the case of several large bridges on the same line of railway. In illustration, the superstructure of the bridge over the River Cavery was alluded to, the spans and all essential particulars being identical. The girders were continuous over two spans, and were thus 140 feet in length. They were ordinary boiler-plate girders, so proportioned as to give a maximum strain of 5 tons per square inch on the extended parts, and of 4 tons per square inch on the compressed parts. Each length of 140 feet was composed of three portions; the central one was 30 feet in length, and had its centre over the middle pier, while the two ends were each 55 feet in length, and extended to the centres of the two adjacent piers. The position of the joints was determined, by calculation, to be at about the points of contrary flexure, in various states of distribution of the load. The three pieces were joined together on a platform adjacent to the abutment; and when this was accomplished, the two girders were connected by cross bracing, and by a system of longitudinal bracing, formed of a "herring-bone" arrangement of half timbers, bolted to the under side of the cross-bearers, by which the rails were carried. It was found, by experiment, that when the ordinary T iron cross bracing alone was fixed, the vibrations of a pair of girders could be increased to about 5 inches, by the application of a moderate lateral force isochronous with these vibrations; whilst on the addition of the herring-bone bracing, it became impossible to produce any appreciable vibration by such means. For the purpose of getting the girders into their places, at the top of each pier, two frames were erected, each carrying two rollers in the lines of the centres of the girders. To the under side of the latter, rails were attached, with their running faces downwards. The girders were first lifted, by jacks, from the platforms, when several rollers were fixed on the platforms, and the girders were then allowed to rest on the rollers. The girders were next hauled forward by a powerful crab tackle, placed on one of the piers in advance, and so were ultimately taken to the further end of the bridge; the remainder being successively hauled over in succession. Having thus always two bearing points, with the centre of gravity between them, there was no tendency to tilt, and no necessity for staging or scaffolding—a material advantage in the case of rivers subject to sudden floods of extreme violence.

February 14th, 1865.

J. R. McCLEAN, Esq., President, in the Chair.

The paper read was, "*Giffard's injector*," by Mr. John England, M. Inst. C.E.

Before entering into a description of this instrument, the author alluded to what had been previously done for raising or forcing water by means of a jet of steam and apparatus without moving parts; in-

cluding the plans of Solomon de Caus, of David Ramseye, of the Marquis of Worcester, of Savery (in 1698), and of the Marquis de Manoury d'Ectot, in 1818. It was observed that when Manoury, by the same means as Savery, had raised water to the height due to atmospheric pressure, instead of, like Savery, carrying it further by means of a steam-jet, he employed a water-jet, on the principle of Montgolfier's water ram, for raising it to the required height; so that Savery's method, though more than a century older than Manoury's, approached nearer to the apparatus under consideration.

In describing the mechanism of the injector, the author divided the instrument into two distinct parts by an imaginary plane at right angles to the axis, through the space between the two nozzles, through one of which the jet of mixed steam and water was forced by the pressure from the boiler, while the other received this jet of mixed steam and water for transmission to the boiler. The instrument consisted of a cylinder, having fixed in it, below the level of the inlet of the feed-water, a conical piece, called the "lance." Sliding in the upper part of this cylinder was a perforated tube, with a tapering termination called the tuyere, and this tube was worked by a handle and screw, by which the area of the annular passage for the feed water, formed by the conical piece in the cylinder and the tapering termination of the tube, could be varied at pleasure, according to the temperature of the feed water and the pressure in the boiler—as the higher the pressure, the greater the opening required. Within the tube there was a solid plug, called the needle, worked by another handle and screw, and likewise having a tapering end, by which the area of the steam passage could be increased or diminished, by the less or greater extent of the insertion of the needle in the tuyere. When adjusted for work, the action of the steam-jet from the tuyere was such, that a column of commingled water and steam, called the "sheaf," was projected in the direction of the axis of the instrument, through the terminus of the lance. In the axis of the lance, and at a short distance from its end, was fixed the second part of the apparatus, consisting simply of a divergent tube, whose properties had long been known, but of the application of which no one appeared to have thought till the inventor of this instrument availed himself of it with so much ingenuity and success. Leading directly to the boiler, this tube was furnished with a valve, which, when the work was stopped, closed with the back pressure.

Two modifications of the first part of the apparatus were then noticed. In one, which had been supplied for a stationary boiler, the tuyere, instead of sliding with the inner tube, was fixed to the cylinder, so that it became the terminus of the steam pipe from the boiler; and the inner tube, instead of carrying the needle, contained the lance and the divergent tube, and was now, when moved towards the fixed tuyere, the water adjustment,—the packing between the water and the steam chambers, which with the moving tuyere was needed, being dispensed with. In the other, which was a modification of the latter by M. Turck, the water chamber was isolated by the inner tube; and the inner tube, instead of carrying the lance and the divergent tube, moved independently of them as well as of the needle; thus, not only dispensing with the packing between the water and the steam chambers, but getting rid of packing altogether.

The form of the lance had been determined principally by experiment. The minimum section of the divergent tube was the unit by which the other parts of the instrument were measured and proportioned, and determined its force of injection. Experiments had given 1·3 for the orifice of the lance, or nearly that of the tuyere; but at very high pressures this must be reduced to unity, the tuyere being then 1·2.

Respecting the physical properties of the sheaf, it was remarked that the indraught of the feed-water was accounted for—in the same manner as the working of water bellows or the blast in locomotive chimneys—by the abstraction of *vis viva*, due to an instantaneous change of velocity. The feed-water mixing with the motor steam, which it partially condensed, resulted in a sheaf made up of minute spheres, which, if received into a glass vessel, disappeared with the cessation of motion. Experiments proved that the velocity of the sheaf, so composed of spherical particles, was greatly in excess of that due to the quiescent force of the water in the boiler which it had to overcome. When leaving the boiler, at a temperature due to its pressure, the steam escaped from the tuyere, and penetrated a liquid whose temperature was much less, a sudden change took place—an instantaneous conversion of heat into work. It was easy to express, algebraically, the useful effect resulting from this work: it was the force of projection with which the sheaf in each time-unit was moving; it was the dynamic quantity which would be turned into useful work. This quantity had for expanssion the incorporation of the mass with one-half the square of its velocity. With this force of projection, the sheaf, after leaving the lance and traversing the space in communication with the atmosphere, encountered the quiescent force of the water in the boiler the moment it passed the minimum section of the divergent tube, the slight taper of which permitted, with minimum friction, the expansion of the sheaf around its axis. As this result of the back pressure from the boiler took place—the velocity of each element being converted into pressure—the sum of these effects represented the total energy of the sheaf. In other words, its pressure, in every successive cross section of the divergent tube, became greater, till, at the end, it attained the maximum and entered the boiler. From the moment onward motion began and the work of injection took place, then, from the contraction of the sheaf in the lance to its expansion in the divergent tube, a simple phenomenon of liquid fluid, as in a conduit, was produced.

The author next alluded, in detail, to a table showing the conditions of working the injector, for which he was indebted to M. Turck, of the Western Railway of France; and gave another table, exhibiting the quantity of water injected per square millimètre of the minimum section of the divergent tube, in gallons per minute, by instruments of four companies, according to experiments made by the "Compagnie de l'Ouest."

The mode of working with the injector on the Western Railway of France was, according to M. Turck, as follows:—steam was maintained to the indicated pressure of 9½ atmospheres: going down inclines, the boiler was filled to the maximum water level; and it was supplied during stoppages at stations, care being taken to arrive with low water. In those stations where the engine had to remain for some hours before starting, the steam was at 2, or at most 3 atmospheres; and as soon

as the engine was chunted, the injectors were set to work to fill the boilers, using up the steam—which would, with pumps and without a donkey engine, be wasted—to 0. There were engine-men who, when the steam was blown off—which seldom happened—were enabled to heat the water in the tender; and who, by feeding on the inclines and at stations, saved—as compared with the same boilers fed with pumps, but without a donkey engine—a kilogramme and a half of fuel per kilometre.

The test of the injector appeared to be its comparison with an apparatus such as Mr. Beattie's, which—abstracting its first cost and that of maintenance—by utilizing the heat of the exhaust steam, and by delivering the water at the boiling point, was asserted to effect a saving of fuel to the extent of $13\frac{1}{2}$ per cent., as compared with any process, other than that of the injector, delivering feed-water at the temperature of 50°. The apparatus was described, but it was contended that this method did not effect a saving of more than 9 per cent. To set against this there was the excess of first cost and of maintenance, the greater liability to accidents, and the increase of back pressure. These were deemed to be so considerable, that most railway companies, both at home and abroad, now adopted the injector for all new engines.

It was observed that the application of this instrument as an elevator opened a wide field for its employment; and, in conclusion, a list was given of all that had been published in France and in this country relative to the injector, which, with exception of the information furnished by M. Turck, had formed the data on which the paper had been prepared.

March 7th, 1865.

The paper read was, "*An account of the drainage of Paris,*" by Mr. H. B. Hederstedt, Assoc. Inst. C.E.

Before describing the modern system, allusion was made to the manner in which the drainage of the city was effected up to the year 1808, when the subject first received thorough investigation, and after which numerous works were undertaken, so that by the commencement of 1832, there was a total length of drains of different kinds of 40,302 metres. The year 1832 marked an important epoch; for then the dreadful ravages of the cholera showed the absolute necessity for cleansing and draining the streets upon a better system than had previously prevailed. An accurate survey of the city, both above and below ground, having been made, levels were taken, and the principal features of each existing drain, or series, were recorded in a tabular form.

As Paris was situated wholly in the valley of the Seine, it was assumed that the drains should empty themselves into that river as far as possible, following the undulations of the streets in a more or less direct course. On the left or southern bank, where the city occupied an even and almost unbroken slope, the drains discharged directly into the river, independent of each other, and without consideration of their ultimate connection, by a transverse sewer parallel with the river, as in the system now in use. The islands of St. Louis and Notre Dame

dipped on each side of a longitudinal ridge coinciding with the centre line of the river, and their surface water at once entered the river, by drains on each slope. On the right, or northern bank, there was one slope bordering on the river, down which the drainage passed into the Seine, and beyond this there was a dip in a northerly direction, towards the brook of Menilmontant, or the track of the "great drain," as it was called, which received the drainage of all the streets on this northern slope, and which finally fell into the river at Chaillot, some distance off on the west. The ridge of this slope was within the present fortifications, and from it descended another slope in a southern direction, now lying beyond the fortifications, but the drainage of which could, if deemed desirable, be placed in connection with the river on the north of and beyond Paris. There were thus five principal divisions, the left bank, the isles of St. Louis and Notre Dame, the right bank southernmost slope, the right bank northern slope, and the extramural slope.

The Seine was subject to heavy floods, but these were fortunately rare, as, during the past two hundred and sixteen years, there were only nine on record. In 1658, the surface of the river rose 28½ feet above its ordinary level. In 1802, when the last flood occurred, the river only rose 6½ feet above the level of the discharging mouth of the modern drain at Asniéres. These floods were all more or less disastrous, sometimes lasting fourteen days, and submerging large areas of the city. To check their recurrence, the low portions of the streets along the banks of the river were raised and walled in, to a point above the influence of floods so severe as that of 1658. There were, however, some parts of the city still exposed to floods, but their effects would be less disastrous, from the efficiency of the new drains, which carried off flood water almost as soon as the river level itself could subside, instead of leaving it to be absorbed or evaporated.

The progress of the drainage works might be gathered from this, that, from the year 1832 to January, 1837, the length of drains was increased from 40,302 to 76,565 metres, while the new works in preparation, and projected, amounted to an additional 20,000 metres.

The position, cost, and object of the several drains, with the difficulties encountered in their construction, were then noticed. During 1833, thirty-three works were completed, of a total length of 15,008 metres, at a cost of about £5. 13*s*. per metre. These included the first drain executed by tunnelling, the side walls of which were built in masonry and the arch in brickwork, at a cost of £8 per metre. In 1834, there were twenty-eight works, having a length of 6,810 metres, and costing £3. 17*s*. 6*d*. per metre. In 1835, twenty-two works were completed, being of the length of 8,713 metres, at a cost of £3. 13*s*. 9*d*. per metre. In 1836, new drains were built in several places, and a sewer was constructed in a quicksand, the rate of progress of which was 8 metres per day.

With regard to the sections of the drains, those of the old and of the new systems differed in two respects. The area of the latter was much larger, though not more effective, and footpaths and rails for carrying waggons were provided. In the former, it was arranged that, as far as possible, all the drains should have a clear height of 6 feet, in order to insure their being properly cleansed. When this height could

not be given, shafts were frequently added, to allow the workmen occasionally to stand upright. The minimum inclination of the drains was 1 in 1000; some were much steeper; and in these steps had been introduced in the inverts, principally at the points of junction with other drains. Up to the end of 1863, there were in operation 217 miles of drains, or more than four times the length in use in 1837.

As to the cleansing of the drains, before the introduction of the mechanical contrivances now in use, it was found necessary to employ hand labour assisted by flushing, in many of the drains having an inclination of 1 in 1000, as that slope was found insufficient to carry off in suspension the solid materials of the drainage. In the smaller drains, rakes or scrapers of wood, cut to the contour of the invert, were worked backwards and forwards, until the mud was drawn to a shaft, through which it was lifted. In the larger ones the brush and rake were still made use of, aided by flushing. From both banks, and from the central islands, all the outlets poured direct into the river, and at the end of 1837, there were probably forty important outlets. Now, with three exceptions, all the discharging mouths had been abandoned, and longitudinal drains, parallel with the river, had been substituted. These finally discharged into the Seine at two places—one within, and the other beyond, the limits of the city.

A description was then given, showing the manner in which both the household and the rain water was disposed of. Night soil, it was remarked, had no connection whatever with the drains, except in one case. Most of the houses in Paris were built in blocks, with a central court-yard common to all, in which there was usually a cesspool for receiving the soil, whence it was removed at intervals. A new plan was now under trial in a few places, chiefly at barracks. This consisted in leading the night soil into cylinders perforated with fine holes, which allowed the liquid portion to rise in an outer cylinder, while retaining the solid matter within. The liquid portion was drawn off daily, and the internal cylinder was emptied as required. In all cases the night soil was carted away from the city, and was deposited in appointed places. A large quantity was converted into manure, at deodorising works, but only what found a ready sale was thus operated upon, so that much still went to waste.

The method of cleansing, and the appliances to effect it, were next noticed. Several of the main drains were composed of two principal parts, of which the lower, or water-way proper, formed but a small proportion of the entire sectional area. Those drains which had no separate water-way were cleansed by hand. The water-way, when forming a distinct part of the work, was of three standard sizes, all cleansed on one principle, but by appliances differing in detail. One was by a cleansing boat, furnished with a scraper at the bow, which nearly filled the section, and was capable of motion in a vertical arc. This scraper formed a dam, and the water rising behind it formed a motive power, which pushed the boat forward, carrying the mud with it. This scraper of course required constant adjustment; and, instead of being a solid disc, it was provided with three openings, the central one of which was always open, while the others were fitted with sliding shutters. A simple arrangement at the stern of the boat kept it true to the axis of the channel. Under the most favourable circumstances,

it seldom happened that a length of more than 800 metres could be thoroughly cleansed in one day, owing to the necessity for going over some places several times. Some of the drains were cleansed by means of a small truck, used with apparatus like that of the boats.

In order to provide for the safety of the workmen, in the event of their being overtaken by a sudden rise of water above its normal level, safety chambers had been built in the roofs, which were reached by openings in the side walls of the drains. In June, 1855, the water rose in the outfall drain, on the right bank of the Seine, to a height of 4 feet 11 inches above the level of the side footpaths; and in that on the left bank the water rose to 7 feet above the same level. Since then, many overflow weirs had been built along these main outfall drains, so as to carry off the surplus water after it had risen above the footpaths.

One leading feature of these works was the absence of small pipes, so constantly used in England. The smallest section ever built, under either the old or the modern system, being 5 feet 6 inches in height, by 2 feet 3 inches in width at the springing of the roof. As only a small portion of the total area was occupied by the water-way proper, the modern plan appeared to be very extravagant. In one case, the large space sacrificed for two water mains was instanced. Another source of heavy outlay arose from this circumstance:—It might have been supposed that one drain of the prevailing large sizes would fully satisfy the requirements of one street. This, however, was not so. A recent Act compelled all householders to build, at their own cost, private branches in communication with the street drains; and, apparently with a view of reducing the pressure of this Act, it had been established that, in all new streets having a width of 72 feet, the City Commissioners should build a drain on each side of the street, so as to shorten the length of transverse drainage. These drains would be under the pavements, and the effect of this Act upon the householders would then be scarcely felt. During the early part of 1864, when the author was in Paris, he noticed the rapid progress of new works in several parts of the city; but in these no provision appeared to be made for the branch drains, which, it might naturally be supposed, would be proceeded with simultaneously with the main drains, to avoid the expense and inconvenience of opening the ground a second time.

The velocity of the current in the Seine was not sufficient to carry off the heavy matter discharged from the drains; consequently mud accumulated in the river bed, which was cleared by dredging, at an annual cost of £3200, being at the rate of tenpence to one shilling per cubic metre. The maintenance of the system was most expensive. involving an outlay, during a recent year, of about £30,000. The author stated, as the result of several personal inspections of the drains at work, that there was a complete absence of unpleasant smell.

The materials used in the construction of the works of the old system were, a rough random rubble plastered—a superior kind coursed—and ashlar, chiefly for the inverts. Concrete was frequently employed in the foundations, as it was now; but the selection of lime for the masonry was formerly not considered important. At present, a coarse gritty sandstone was extensively used, set in random rubble fashion,—the stone forming perhaps not more than 40 per cent. of the work, and the staple

material being mortar. The sand for this mortar was coarse and fine together, as taken from the pit; the result being a concrete rather than a mortar, which was employed in a dry stiff state. The work, nevertheless, was strong, attributable, it was believed, to good hydraulic lime being employed. Within the last three years, a new building material, concrete, or béton "Coignet," had been introduced, the use of which had already been found to be satisfactory. This concrete was composed of sand, or ballast, dredged from the Seine, mixed with hydraulic lime and Roman cement. The cement was required to weigh 2800 lbs. to 3,100 lbs. per cubic metre. This concrete cost £1. 12*s.* per cubic metre in position in the drains, but the varieties of the mixture caused the price to fluctuate between £1 and £3. 5*s.* per metre. The mode of building with this material was described in detail.

In conclusion, the author gave a schedule of the rates paid for masonry, and of the prevailing prices of the materials used in the construction of the works; and offered his acknowledgments to M. Belgrand, the engineer-in-chief, for courteously placing at his disposal all the records connected with the works, as well as for allowing him permission to inspect them.

MECHANICAL ENGINEERS' SOCIETY.

(Continued from page 111.)

"*On the distribution of weight on the axles of locomotives,*" by Mr. John Robinson, of Manchester.

Amongst the causes affecting the steadiness of locomotive engines in motion, and thereby also the general steadiness of trains on railways, the distribution of weight upon the various axles, it is believed, has not received the amount of consideration which the subject deserves. There are numerous circumstances which must necessarily be taken into consideration for determining the position of the axles of an engine relatively to its general mass. The most important object is to obtain sufficient weight upon the driving wheels, whether single or coupled, for giving the amount of adhesion necessary to draw the load and ascend the gradients for which the engine is to be adapted: and another consideration of great importance in fixing the position of the axles is the number and sharpness of the curves on the road along which the engine has to pass. These two conditions naturally influence the distance between the several axles of the engine, especially the extreme ones, the distance between which is called the "wheel base."

These two main conditions, of the weight on the driving wheels and the nature of the curves on the line, being fixed, the question arises how best to distribute the weight of the engine on its axles. Locomotives in general may be divided for the present purpose into fifteen classes, each of which presents different obstacles to obtaining a proper distribution of weight upon the axles. The figures indicating the weights at the several axles are taken with an ordinary working quantity of water and fuel in the boiler and fire-box, and in the tank engines, with the tanks fully loaded.

Four-wheeled engines, having inside cylinders, are generally used for mineral and coal lines, and for forming trains at stations. A very large amount of weight here comes upon the hind axle, in consequence of the overhanging fire-box, and this can only be alleviated by making the boiler unusually long, in proportion to the fire-grate and flue area. The actual weights upon the axles of such an engine in working order, with cylinders 14 inches diameter by 20 inches stroke, and wheels 3 feet 9 inches diameter, have been ascertained by the weighing machine to be:—Leading axle, 6·00 tons; hind axle, 12·50 tons: total adhesion weight, 18·50 tons. And with an elongated boiler the weights are—Leading axle. 7·38 tons; hind axle, 11·80 tons; total adhesion weight, 19·18 tons. The weight required for maximum adhesion in this engine is 18·49 tons; that is, the weight required for making use of the maximum power of the engine, under the most favourable circumstances when the adhesion friction is at its maximum amount of 1-5th of the load, and the mean effective steam pressure in the cylinders throughout the stroke being taken at 95 lbs. per square inch in starting the train.

The unequal distribution of weight upon the axles of four-wheeled engines above shown, may to some extent be avoided by placing the cylinders outside the frame; for in this case the increased weight forward of the cylinders and their attachments, and the possibility of getting the straight driving axle much nearer to the fire-box than a crank axle could be placed, tend more nearly to equalise the weight upon the two axles. On the other hand, a less substantial engine is thus obtained, especially where coupled; since the coupling rod, passing inside the connecting rod and the slide bars, renders it difficult to secure a good attachment to the frames. The actual weights ascertained upon the axles of such an engine in working order, with cylinders 15 in. diameter by 24 in. stroke, and wheels 4 ft. 6 in. diameter, have been:—Leading axle, 10·00 tons; hind axle, 11·25 tons: total adhesion weight, 21·25 tons—the weight required for adhesion being 21·25 tons.

In four-wheeled tank engines, in which the supply of water and fuel is carried by the engine itself, by arranging the position of the water tank so as to keep its own weight, as well as that of the water it contains, well forward, the leading axle may be made to bear a larger proportion of the additional weight than the hind axle, whether the cylinders be placed inside or outside the frames. This is, however, counterbalanced by the necessity for lengthening the foot-plate, and fencing it at the back, for the purpose of carrying the fuel, thereby increasing the weight overhanging the hind axle. The actual weights obtained in such an engine, with inside cylinders 13 in. diameter by 18 in. stroke, and wheels 3 ft. 9 in. diameter coupled, have been:—Leading axle, 7·45 tons; hind axle, 14·95 tons: total adhesion weight, 22·40 tons—the weight required for adhesion being 14·37 tons.

The next class of engine is that which has hitherto been con[illegible] the ordinary type of passenger engine, having six wheels all un[illegible] the middle or driving axle being placed under the cylindrical [illegible] the boiler, in front of the fire-box, the leading axle behind [illegible] and the hind axle behind the fire-box. In [illegible] description, it is usually sought to have [illegible]

middle axle, then a less weight upon the leading, and a still less weight upon the hind axle; but to have these weights not so disproportionate as that it shall be impossible to vary the weight upon the middle axle, within a moderate range, by a corresponding adjustment of that upon the leading axle. In this respect the inside-cylinder arrangement presents an advantage over that with outside cylinders: since the leading axle in inside-cylinder engines can be placed much nearer to the smoke-box, and the weight upon it thereby diminished, on account of the cylinders not interfering with the leading wheels, as in outside-cylinder engines. The connecting rod also is then capable of being made longer, in consequence of the increased distance from the smoke-box at which the middle axle may be placed without throwing too much weight upon the leading axle, which in engines with short boilers is often a matter of considerable importance. It may be remarked, that the arrangement of uncoupled engines with all the axles under the cylindrical part of the boiler is now almost discarded, at least in this country; since they are found to be so unsteady, in consequence of the overhanging weight of the fire-box, that high speeds cannot be safely accomplished with them.

In an example of inside cylinder passenger engine, having cylinders 15 in. diameter by 20 in. stroke, middle wheels 5 ft. 6 in. diameter, and leading and hind wheels 3 ft. 6 in. diameter, the total weight, being 23·06 tons, was distributed as follows:—leading axle, 8·16 tons; middle axle, 10·10 tons; hind axle, 4·80 tons; total adhesion weight 10·10, the weight required for adhesion being 14·48 tons.

An example of a favourable distribution in an outside-cylinder passenger engine is the "Lady of the Lake," of the London and North Western Railway, shown at the International Exhibition of 1862. With cylinders 16 in. diameter by 24 in. stroke, middle wheels 7 ft. 7½ in. diameter, leading and hind wheels 3 ft. 8 in. diameter, the distribution of the weight is:— Leading axle, 9·40 tons; middle axle, 11·50 tons; hind axle, 6·10 tons: total adhesion of weight, 11·50 tons—the weight required for adhesion being 14·24 tons.

The construction of uncoupled engines with tanks is not of very frequent occurrence. As, however, many such engines were made formerly, the distribution of one is given, with the tank placed under the footplate behind the fire-box: inside cylinders 15 in. diameter by 20 in. stroke, middle wheels 5 ft. 6 in. diameter, leading and hind wheels 3 ft. 6 in. diameter. The distribution was:— Leading axle, 7·35 tons; middle axle, 10·25 tons; hind axle, 6·95 tons: total adhesion weight, 10·25 tons—the weight required for adhesion being 14·48 tons. The placing of a tank under the cylindrical portion of the boiler in an outside-cylinder uncoupled engine simply tends to increase the weight upon the leading axle, already too heavily loaded, and has not been extensively adopted within the range of the writer's observation.

During the past few years there has existed in this country a growing tendency to adopt engines with four coupled wheels for the passenger trains on the great trunk lines, and for the mixed trains on shorter and branch railways. In the former case, in consequence of the great number of passenger carriages required in many of the trains; and in the latter, owing to the desirability of having engines of sufficient power to work trains composed partly of passengers and partly of goods. In

most cases such engines have been built with small leading wheels, and with the middle and hind wheels coupled, under the impression that it is safer to run at high speeds with wheels of small diameter in front than if their size was such as is usually employed when coupled for driving. In regard to the best distribution of weight upon the axles of such engines, it is evident that the difficulty is, whether, in the case of inside or outside-cylinder engines, to get a fair proportion of weight upon the hind wheels, so as to justify their being coupled to the middle wheels, assuming the position of the hind axle to be behind the fire-box. And to show that this question is not easy of solution, the following instances are given of the distribution of weight upon the axles of such engines.

Coupled passenger engine with outside cylinders 16 in. diameter by 22 in. stroke, middle and hind wheels coupled 5 ft. 7 in. diameter, leading wheels 3 ft. 7 in. diameter—total weight, 31·60 tons: of which the distribution is:—Leading axle, 10·80 tons; middle axle, 11·85 tons; hind axle, 8·95 tons: total adhesion weight, 20·80 tons — the weight required for adhesion being 17·83 tons. In this engine a heavy cast-iron block was added, forming the foot-plate, in order to obtain the above distribution of the weight.

In the case of engines with inside cylinders, it is more easy to load the hind wheels sufficiently, to prevent an exaggerated load upon the leading wheels; because the latter being placed more forward in the engine than is usually possible with outside cylinders, the weight on them is diminished; and when the middle axle is relieved from unnecessary weight, by adjustment of the springs, a greater proportion is taken by the hind wheels than would be the case if the leading wheels were nearer the middle wheels. In such an engine, with cylinders 15 in. diameter by 20 in. stroke, middle and hind wheels 5 ft. 6 in. diameter, leading wheels 3 ft. 6 in. diameter, total weight 25·80 tons, the distribution has been:—Leading axle, 8·39 tons; middle axle, 10·00 tons; hind axle, 7·41 tons: total adhesion of weight, 17·41 tons —the weight required for adhesion being 14·48 tons. In this engine, extra weighting of the foot-plate, was not required.

Another example of this class of engine is that in which the sloping of the bottom of the fire-box upwards, from front to back, allows of the hind axle being placed under the ashpan, whereby it carries a much larger share of the weight of the engine than would otherwise be possible. An engine with cylinders 17 in. diameter by 22 in. stroke, middle and hind wheels 6 ft. 6 in. diameter, leading wheels 4 ft. 0 in. diameter, had the following distribution:—Leading axle, 9·36 tons; middle axle, 11·57 tons; hind axle, 9·71 tons: total adhesion of weight, 21·28 tons—the weight required for adhesion being 17·29 tons.

When it is desired, as is not unfrequently the case, to construct such engines for carrying their own supply of fuel and water, it is easy so to arrange the position of the tanks as to get an excellent distribution of weight upon the wheels; and if the tanks be conveniently placed on the side frames, pretty equally over the coupled axles, the loading and unloading of the coupled wheels, in moderately equal proportions, is secured, when the tanks are first filled, and afterwards gradually emptied, by the supply to the boilers: whereas, when the tank is placed under the foot-plate, the hind axle has a much larger proportion of the gross weight of the engine to carry when the tank is full than when it

is empty. The weights obtained in an engine of this class, with cylinders 15 in. diameter by 20 in. stroke, middle and hind wheels 5 ft. 0 in. diameter, leading wheels 3 ft. 6 in diameter, have been :—Leading axle, 8·50 tons; middle axle, 10·13 tons; hind axle, 9·51 tons: total adhesion weight, 19·64 tons — the weight required for adhesion being 15·94 tons.

One of the most generally useful classes of engine for the common purposes of railways is the six-wheeled engine, having the four front wheels coupled, since it can be used for ordinary goods trains, or for heavy passenger trains when not run at too great a speed. The advantage of such an arrangement of engine, if made with inside cylinders, is that nearly the whole weight of the engine may be conveniently distributed upon the four coupled wheels, leaving but a small proportion for the hind wheels, which, in this case, do little more than serve to avoid the disadvantages of an overhanging fire-box. The following is a good example of distribution of weight on the axles of an engine of this class, with inside cylinders 16 in. diameter by 22 in. stroke, leading and middle wheels 5 ft. 0 in. diameter, hind wheels 3 ft. 6 in. diameter:—Leading axle, 9·77 tons; middle axle, 10·27 tons; hind axle, 4·42 tons: total adhesion weight, 20·04 tons — the weight required for adhesion being 19·91 tons.

By changing the relative positions of the leading and middle axles, the distribution of the weight in the last example may be varied as required, without danger of getting a disproportionate length of connecting rod. But where such engines are to be constructed with outside cylinders, a difficulty as to distribution immediately arises, since the large diameter of the front wheels renders it necessary that the leading axle be placed at a considerable distance behind the cylinders; and thus a much larger proportion of the weight of the engine is thrown upon the leading wheels than is either necessary or desirable. The distribution obtained in an engine with outside cylinders 15 in. diameter by 22 in. stroke, leading and middle wheels 4 ft. 6 in. diameter, has been :—Leading axle, 10·00 tons; middle axle, 11·07 tons; hind axle, 4·62 tons: total adhesion weight, 21·07 tons — the weight required for adhesion being 19·47 tons.

Engines of this class are sometimes required to carry their own supply of water and fuel; in which case it seems most desirable to place the water tank on the top of the boiler, so as to increase the load proportionately on the coupled wheels, and let the hind wheels carry the increased weight involved in the fuel boxes and fuel. The distribution of weight in a "saddle" tank engine, having inside cylinders 14 in. diameter by 20 in. stroke, leading and middle wheels 4 ft. 9 in. diameter is: —Leading axle, 9·60 tons; middle axle, 11·24 tons; hind axle, 5·07 tons: total adhesion weight, 20·84 tons — the weight required for adhesion being 14·59 tons. Should it be desired to add tanks to engines of this class with outside cylinders, it is clear that a certain amount of the superfluous weight upon the leading wheels might be counterbalanced by placing the tank under the foot-plate; but the disadvantage would still continue of disproportionately loaded axles, according as there was a greater or less quantity of water in the tank.

The next class of engines to be referred to is that used for heavy goods traffic with all six wheels coupled. Such engines, constructed

with inside cylinders, are very common, though a good distribution of weight upon their axles is not easy, since the hind axle, when placed behind the fire-box, has naturally but a comparatively very small proportion of the weight of the engine to carry; and if, in order to obviate this disadvantage, it is sought to move the middle axle nearer to the cylinders, the due length of the connecting rod is sacrificed, unless the length of the boiler be increased, giving a corresponding increase in the wheel base of the engine; which, in railways having sharp curves, is by no means desirable, especially in an engine having all the wheels coupled. A favourable distribution of weight in an engine of this kind with inside cylinders, 16 in. diameter by 24 in. stroke, and wheels 5 ft. 1½ in. diameter, is:—Leading axle, 10·60 tons; middle axle, 10·90 tons; hind axle, 7·25 tons: total adhesion of weight, 28·75 tons — the weight required for adhesion being 21·18 tons, and the wheel base 16 ft. 3 in.

A large number of engines with six coupled wheels have been built with all their axles underneath the cylindrical part of the boiler, so as to attain the double object of a short wheel base and a more equal distribution of weight upon the axles. With such an arrangement the following have been the results, in an engine with inside cylinders 18 in. diameter by 24 in. stroke, and wheels 5 ft. 0 in. diameter:—Leading axle, 7·70 tons; middle axle, 10·35 tons; hind axle, 9·95 tons: total adhesion weight, 28·00 tons—the weight required for adhesion being 27·45 tons, and the wheel base 12 ft. 2 in. The advantage so obtained of a short wheel base is, however, counterbalanced to a considerable extent by the instability created by the overhanging fire-box, which, when the fire-box is large, is a matter of serious importance.

As a mean between the extremes of the last two examples, stands the six-wheeled goods engine, with long fire-box, having the grate sloping upwards from front to back. In this case the wheel base is shortened, and the weight on the hind axle, which is placed under the ashpan, is increased, as compared with engines having the hind coupled axle behind the fire-box. The distribution of weight in such an engine, with inside cylinders 17 in. diameter by 24 in. stroke, and wheels 5 ft. diameter, has been:—Leading axle, 10·64 tons; middle axle, 11·57 tons; hind axle, 9·73 tons: total adhesion weight, 31·94 tons—the weight required for adhesion being 24·53 tons, and the wheel base 15 ft. 6 in.

The construction of engines having six coupled wheels with outside cylinders, although frequently met with on the continent, is in this country very unusual, since such an arrangement aggravates the disproportion between the weight upon the leading and that upon the hind axle, when the hind axle is placed behind the fire-box. The distribution obtained in an outside-cylinder engine, with overhanging fire-box, having cylinders 17¼ in. diameter, by 24½ in stroke, and wheels 4 ft. 3 in. diameter, has been:—Leading axle, 11·20 tons; middle axle, 10·46 tons; hind axle, 10·95 tons: total adhesion weight, 32·61 tons—the weight required for adhesion being 30·35 tons, and the wheel base 11 ft. 0 in.

For mineral and coal traffic, engines are frequently constructed having six wheels coupled, and with tanks for their water and fuel supply. As in the case of other engines with the hind wheels coupled, so here the position of the tanks can be so arranged as to equalise the unfavourable distribution of weight upon the hind wheels when the hind axle is placed behind the fire-box.

In some instances such engines are constructed with the tank under the foot-plate; but these are again subject to the disadvantage of too great a variation in the weight upon the hind wheels, depending upon whether the tank and fuel boxes are empty or full.

On mineral railways, having sharp curves, it is frequently desired to reduce the wheel base to the smallest possible limit, and, consequently, all the axles of the engines are placed between the fire-box and smoke-box. Under these circumstances, the tank has to be placed on the top of the boiler, and so arranged that, whether full or empty, each pair of wheels shall be proportionally loaded and relieved. The distribution of weight in such an engine, with inside cylinders 16 in. diameter, by 24 in. stroke, and wheels 4 ft. 6 in. diameter, has been—leading axle, 8·50 tons; middle axle, 11·00 tons; hind axle, 10·75 tons: total adhesion weight, 30·25 tons—the weight required for adhesion being 24·13 tons, and the wheel base 11 ft. 8 in.

Bogie engines have been rendered necessary by the construction of railways with not very heavy permanent way and sharp curves; in consequence of which a short wheel base has become a necessity, and in heavy engines it has been found requisite to carry the weight of the leading end upon four wheels instead of upon two, the wheels being placed very far forward, and thereby necessitating considerable lateral freedom of motion upon the curves. Engines of this class working with tenders, and having their middle and hind wheels coupled, are used almost universally on the American railways, both for passenger and goods traffic. It appears that, in engines so constructed, a considerable amount of the weight of the engine, which ought to be available for adhesion, is carried on the bogie wheels, in consequence of the increased weight of the engine, involved in the use and construction of the bogie, together with the heavy spark-catching chimney, and the usual cow-catcher in front. An incidental objection to the use of bogies, is the necessity for employing wheels of small diameter, so as to obtain clearance under the frames and cylinders, their diameter being usually less than that of the carriage and waggon wheels. The weights obtained in an engine of this kind, with outside cylinders 13 in. diameter by 18 in. stroke, and four coupled driving wheels, 5 ft. 6 in. diameter, have been—bogie axles, 8·00 tons; middle axle, 8·50 tons; hind axle, 7·50 tons: total adhesion weight, 16·00 tons; the weight required for adhesion being 9·79 tons, and the wheel base 13 ft. 6 in. from centre of bogie to hind wheel centre. When it is desired to carry a water tank in such engines, the tank may be so arranged as to throw all the additional weight upon the coupled wheels, and, indeed, as far as possible, to equalise the weight upon them.

With regard to the general principles of distribution of weight upon the axles of six-wheeled locomotive engines, it seems to be the common opinion that the middle axle, to which the power is first applied from the cylinders, should carry the greatest weight, and next to this the leading axle, thus leaving the lightest load to be borne by the hind axle; this arrangement being thought desirable, with a view to keep the front of the engine heavier on the rails than the hind end, and so secure it from risk of jumping off. The writer would, however, suggest whether such a necessity for placing a greater load on the leading than on the hind axle really exists; since it seems unlikely that any engine,

with a reasonable weight upon the leading axle, and consequently with a reasonably strong spring for keeping the wheels down on the road in the event of blows being received, could ever leave the line merely because the hind axle carried a greater amount of weight than the leading axle. It should further be remembered, that in all cases where the hind wheels of an engine are coupled, and the leading wheels not so, an arrangement which is becoming more and more frequent, it is absolutely desirable, in order to obtain the maximum adhesion, that the hind coupled wheels should carry a weight nearly equal to that upon the middle wheels, and consequently greater than that usually placed upon the leading wheels. In this respect there is a disadvantage in the employment of engines with outside cylinders, because of the greater weight of the front part of the engine in that arrangement, and the consequent loss of a larger proportion of the total weight for adhesion. This objection applies only to outside cylinder engines having their leading wheels uncoupled; but, on the other hand, to couple the leading wheels of such engines involves considerable complications and difficulties.

Another point of interest connected with the distribution of the weight is the effect produced upon the stability of a locomotive by the difference between the portion of weight carried upon each spring and the total weight carried by the rail at each wheel: in all the preceding examples of distribution that have been given, the weights stated are those upon the rails at each axle. In engines with inside cylinders this difference is often very considerable, and must exercise a great influence upon the tendency to rise and fall on the springs; and often when, in taking account of the weight upon the rails only, the front pair of wheels is found to press upon the rails with a less weight than the hind wheels—the fact is lost sight of that the weight upon the leading springs is greater than upon the hind pair, and the tendency to leave the road is consequently diminished in front. This arises from the circumstance that, in the case of the middle and hind coupled wheels, the weight of the parts not carried by the springs—namely, the wheels, axles, axle boxes, springs, and gearing—is greatly in excess as compared with the weight of the corresponding parts not carried by the front springs.

The difficulties now presented to the proper distribution of weight upon the axles of locomotives are considerably increased by the prevalent adoption of sharper curves in the construction of railways than were formerly used, and the consequent necessity for shortening the wheel base. Continental engineers have been driven, by similar difficulties, to adopt, in a large number of cases, the plan of placing all the axles of the engine under the cylindrical part of the boiler; thus gaining a short wheel base by letting the fire-box overhang behind. This plan is liable to considerable objection, on account of overloading the hind axle of the engine to such an extent as to cause a galloping motion when running fast; and as it has now become more necessary, from the introduction of coal as fuel, and for other reasons, to adopt fire-boxes of larger dimensions and increased weight, the objection to their overhanging the hind axle has been proportionately increased. At the same time the arrangement of sloping fire-grate, already referred to, greatly facilitates the adjustment of weight upon the hind wheels;

since, when the frames are placed outside the wheels, the axle may pass across under the fire-box at any point necessary to bring the desired weight upon it, so that not only is the long wheel base avoided, but also the overhanging of the fire-box; while the instability of the engine consequent upon the latter is guarded against. An unavoidable weight is often thrown upon the leading uncoupled axles of locomotives by the obligation of keeping the middle axle sufficiently far back to get adequate length of connecting rod: hence it becomes necessary, in some instances, either to increase the length of the boiler, in order to obtain sufficient weight behind the middle axle,—thus involving a considerable lengthening of the wheel base; or else to adopt the heavy sloping fire-box, accompanied by outside frames.

By care in arranging the position of the middle axle of a locomotive in relation to the centre of gravity of the mass carried upon the springs (not the centre of gravity of the whole engine) a fair distribution of the weight may usually be secured. It is evident that only the portion of the engine above the springs can be affected by the adjustment of the spring attachments; and it will be found that the centre of gravity of this portion varies to the extent of some inches from that of the whole mass of the engine. Taking them as a basis, the centre of gravity of this adjustable portion of the engine, the effect produced upon the distribution of the load by any alteration, either in the position of the axles or in the screwing up of the spring links, can be readily calculated by dividing the total adjustable load in such proportions that the products of the several loads upon the axles multiplied by their respective distances from the centre of gravity, shall balance one another on each side of that centre.

In the following example the results thus obtained by calculation were verified by the actual weights upon a weighing machine, in the case of a single passenger engine, having the centre of gravity of the adjustable load 8¼ inches in front of the middle axle, the leading axle being 6 ft. 8 in. in front of the middle axle, and the hind axle 8 ft. behind it. The several distances of the axles from the centre of gravity were consequently—leading axle, 71¾ in. forward, and middle and hind axles, 8¼ in. and 104¼ in. respectively backward. The middle driving springs were screwed up in the three weighings, according to the several different adjustments enumerated; the load then apportioning itself correspondingly at the leading and hind axles, as follows:—

	Leading axle. Tons.		Middle axle. Tons.		Hind axle. Tons.		Total Weight. Tons.
1st weighing	11·85	+	10·20	+	8·05	=	30·10
2nd ,,	10·55	+	12·50	+	7·05	=	30·10
3rd ,,	9·65	+	14·20	+	6·25	=	30·10

These being the actual results ascertained by the weighing machine, the following are the results obtained by calculation of the distribution of the weight, starting, in each case, with the respective loads above given at the middle axle. The constant weight at the several axles (that is, the weight of the wheels, axle, axle-boxes, springs, and gearing) was, leading 1·76 tons, middle 3·66 tons, and hind 1·68 tons; total 7·10 tons, leaving 23·00 tons adjustable weight above the springs.

Calculated Distribution of Weight.

		Leading axle.	Middle axle.	Hind axle.	Total Weight.
		Tons.	Tons.	Tons.	Tons
1st weighing.	Adjustable weight .	10·09	6·54	6·37	23·00
10·20 tons	Constant " .	1·76	3·66	1·68	7·10
at Middle axle. (*See Note* A.)	Total . . .	11·85	10·20	8·05	30·10
2nd weighing.	Adjustable weight .	8·83	8·84	5·33	23·00
12·50 tons	Constant " .	1·76	3·66	1·68	7·10
at Middle axle. (*See Note* B.)	Total . . .	10·59	12·50	7·01	30·10
3rd weighing.	Adjustable weight .	7·91	10·54	4·55	23·00
14·20 tons	Constant " .	1·76	3·66	1·68	7·10
at Middle axle. (*See Note* C.)	Total . . .	9·67	14·20	6·23	30·10

The effect that would be caused in relieving the leading axle of a portion of the weight by shifting the position of the middle axle in this engine, is ascertained by the following calculation for a case of shifting the axle 6 in. more forward, in the instance of the second of the above adjustments of the middle springs, with 12·50 tons total at the middle axle:—

(*See Note* D.)	Leading axle. Tons.		Middle axle. Tons.		Hind axle. Tons.		Total Weight. Tons.
Adjustable weight...	8·53	...	8·84	...	5·63	...	23·00
Constant "	1·76	...	3·66	...	1·68	...	7·10
Total	10·29	...	12·50	...	7·31	...	30·10
In place of the actual weights	10·55	...	12·50	...	7·05	...	30·10

the effect produced being, therefore, a transference of ¼ ton from the leading to the hind axle, by shifting the middle axle 6 in. forwarder.

In the case of engines with the middle and hind wheels coupled, compensating or connecting levers are frequently employed, for the purpose of equalizing the weights on the two driving axles. The back end of the middle spring, and the front end of the hind spring, are connected together by a lever, which is attached to the frame of the engine by a centre pin, on which it vibrates, the other two ends of the springs being each connected direct to the frame as usual. When the two arms of the lever are equal in length, the weights carried by the two springs are necessarily rendered equal, however different they may have been when the springs were attached direct to the frame at both ends, before connection by the lever; because the forces of tension at the two ends of an equal-armed lever must always be equal. This change in the distribution of the load is produced by the more heavily

---

		Tons.		Ins.		Tons.		Ins.		Tons.		Ins.
Note A.	...	10·09	×	71½	=	(6·54	×	8½)	+	(6·37	×	104½)
" B.	...	8·83	×	71½	=	(8·84	×	8½)	+	(5·33	×	104½)
" C.	...	7·91	×	71½	=	(10·54	×	8½)	+	(4·55	×	104½)
" D.	...	8·53	×	71½	=	(8·84	×	2½)	+	(5·63	×	104½)

loaded middle spring becoming partially released from compression, adding, at the same time, to the compression of the more lightly loaded hind spring through the action of the connecting lever. The effect of the connecting lever is thus to blend the two springs into one, and to produce the same distribution of load as if the middle and hind axles were removed and replaced by a single axle fixed in the position of the axis of the connecting lever, and carrying their combined load; thereby transforming the engine in effect into a four-wheeled engine. Exactly the same result, however, can be produced without the connecting lever, by simply screwing up the hind spring to the same extent as it is compressed by the action of the lever, and slacking back the middle spring to the corresponding extent. But the objectionable result then arises in both cases alike, that a portion of the load of which the middle wheels are relieved is thrown upon the leading wheels, thereby causing the loss of so much of the total driving adhesion; since the leading axle is the fulcrum upon which the engine is lifted when screwing up the hind springs. Where the connecting lever is inserted between the leading and middle springs, the same remark applies to the effect produced on the distribution of the weight as where the middle and hind springs are connected by a lever; that no distribution of the weight is thereby obtained which cannot be equally obtained with independent springs. It has to be remarked, however, that in consequence of the engine being transformed virtually into a four-wheeled engine, by the insertion of connecting levers, the original distribution of the weight can never be altered in any degree after the engine is built and fitted with the levers; whereas, with independent springs, the six-wheeled engine retains the full advantage of its three axles, whereby the original distribution of the weight can be altered at any subsequent time within a very extensive range, as is seen by the example already given of the three weighings of the same engine. Moreover, with a connecting lever of equal arms, although the weights upon the connected springs are rendered equal, the pressure of the wheels upon the rails, and, consequently, their adhesion, will still be unequal, on account of the greater weight of the middle axle and gearing.

The use of the connecting lever has an independent advantage in passing over an inequality in the rails, because the second spring connected by it partly shares in each deflection of the first spring, and the play of the first spring is thereby diminished to that extent; but the same result is attained with independent springs by employing proportionately longer springs whenever practicable. It has to be noticed, moreover, that, with the connecting lever, the objection is incurred of causing the breaking down of both springs in the event of the failure of either of them. In connecting the leading with the middle springs, levers with unequal arms have sometimes been employed, the length of the arms being inversely proportionate to the loads on the two springs, so that the distribution of the load is not disturbed by inserting the levers. In this case, the levers have the same action, as before, of lessening the play of the springs in running over any inequality in the rails; but the same objection, of causing a break down of both springs by any failure of either, applies, though with greater force, in the case of the leading springs, on which the safe running of the engine depends.

Provisional Protections Granted.

Cases in which a Full Specification has been deposited.

1865.

389. Theodor Anton Verkruzen and Moritz Anton Verkruzen, of Hatton-garden, impd. winder and arrangement for winding and putting up velvet and other ribands.—*February 11th.*

412. William Boxer Newbery, of Boston, Suffolk, U.S.A., impts. in the manufacture of files,—a communication. —*February 14th.*

537. John Askew, of Charles-street, Hampstead-road, impts. in the construction of a portable vehicle for teaching children to walk, and giving assistance to invalids.

540. Edward Henry Eldredge, of Boston, U.S.A., a magazine repeating and breech-loading rifle,—a communication.

The above bear date February 25th.

556. Solomon Sally Gray, of Boston, U.S.A., impts. in paper and cloth-lined paper collars for ladies and gentlemen.—*February 28th.*

588. William Sparks Thomson, of Paris, impts. in covered steel for crinoline skirts, and in the machinery for covering and uniting the same,—a communication.—*March 2nd.*

623. Timothy Sheldon Sperry, of New York, impt. in covered springs for clothing, and in means for manufacturing the same; applicable also to other purposes.—*March 6th.*

643. John Dean, of Handsworth, near Birmingham, impts. in marine steam engines.—*March 8th.*

Cases in which a Provisional Specification has been deposited.

1864.

2704. William Smith, of Salisbury-street, Strand, impts. in tanning leather, and in the apparatus to be employed for that purpose,—a communication.—*November 2nd.*

2719. Charles Garton, of Bristol, and Thomas Hill, of Southampton, impts. in brewing, fermenting, racking, and bottling beer, ale, and wine.—*November 3rd.*

2748. Adolphe Estourneaux and Louis Beauchamps, of Denain, impts. in non-conducting composition for preventing the radiation or transmission of heat or cold.—*November 7th.*

2769. Louis Charles Méaulle, of Caen, France, impd. stamping machine.

2770. Charles Garton, of Bristol, impts. in obtaining power from liquids.

The above bear date November 8th.

2789. John Robinson and James Gresham, of Manchester, impts. in that apparatus for raising and forcing fluids and feeding steam boilers, known as "Giffard's injector."

2791. Marc Antoine François Mennons, of Paris, impts. in globes or shades for lighting apparatus,—a communication.

The above bear date November 10th.

2811. Walter Christopher Thurgar, of Norwich, and Robert Arthur Ward, of Maidenhead, impts. in developing heat, boiling water, and generating steam.—*November 11th.*

2969. Marc Antoine François Mennons, of Paris, impts. in hot blast furnaces,—a communication.—*November 29th.*

3248. Henri Adrien Bonneville, of Paris, impts. in machinery for manufacturing shoes for horses and other animals,—a communication.

3249. Henri Adrien Bonneville, of Paris, impts. in the construction of presses for pressing hay, cotton, fruit, and other highly compressible substances,—a communication.

The above bear date December 30th.

1865.

22. William Clark, of Chancery-lane, impts. in electro-magnets and their application to telegraphic and other purposes,—a communication.
27. Nathan Thompson, of Abbey-gardens, St. John's Wood, impts. in stoppers for bottles, jars, vessels, and tubes, also for ordnance and fire-arms.

The above bear date January 4th.

42. Jules Lebaudy, of Paris, system of boiling grained sugar in vacuo.—*January 6th.*
59. William Baker, of Sheffield, impts. in the manufacture and refining of iron and steel.
65. John Welsh, of Perth, N.B., impd. method of lighting street and other lamps, and in the apparatus or means connected therewith.

The above bear date January 9th.

76. William Bayliss, of Wolverhampton, impts. in standards for strained wire or rod fencing.—*January 10th.*
82. John Frederick Spencer, of Newcastle-on-Tyne, impts. in regulating and working the valves of steam and other engines.
90. Robert Tempest, of Rochdale, impts. in machinery for opening and carding cotton and other fibrous materials.

The above bear date January 11th.

101. Frederic Barnes, David Hancock, and Edward Cowpe, all of Wycombe, Buckinghamshire, impts. in the method of, and apparatus for, applying electro-magnetism as a break power to railway and other carriages and machines.
105. Rudolph Frederick Moll, of Manchester, impts. in apparatus for examining, cleaning, and repairing the bottoms and sides of ships while afloat; which apparatus is also applicable for other purposes.

The above bear date January 12th.

127. James Young, of Limefield, Mid-Lothian, N.B., impts. in producing gases and vapour in a heated state.—*January 14th.*
146. François Paul Henri Cahuzac, of Paris, impts. in apparatus for ironing and dressing woollen and other tissues,—a communication.
151. John William Gregg, of Dublin, impts. in street and other lamps and lanterns.

The above bear date January 18th.

159. Adolf Wilhelm Preger, of Oldham, impd. arrangements for coupling steam engines, turbines, or other apparatus employed as motive-power,—a communication.
160. Melchor Beltzhoover Mason, of New York, impd. method of purifying and oxidizing metallic ores.
162. Edward Williams, of Miles-Platting, near Manchester, impts. applicable to throstle, worsted spinning, and doubling frames.
166. William Cleveland Hicks, of New York, impts. in steam-engines.
168. Tasso Labrousse and John Keily, of Dublin, impts. in dyeing leather.

The above bear date January 19th.

172. John Turney, the younger, and George Wood, of Sneinton, Nottinghamshire, impts. in machinery or apparatus employed for fluting, dicing, cross-graining, glazing, and all kinds of jiggered work on skins or hides, and having a self-acting table and revolving friction wheel or roller.
174. Louis Balma, of Paris, impd. machine for raising and carrying earth, sand, stones, or other similar solid or liquid materials for dredging, ventilating, or winnowing grain, or other analogous purposes.

The above bear date January 20th.

190. John Eadie, of Glasgow, impts. in boots and shoes.
201. Michael Alexander Dietz, of St. Paul's-buildings, City, impts. in petroleum and coal oil burners and glasses.
202. Benjamin King, of Ipswich, impts. in the manufacture of manure.

The above bear date January 23rd.

204. Charles Tennant Wells, of Bouverie-street, Fleet-street, impts. in ground vineries or glass ridges for the cultivation of grapes or other fruit.

205. Richard Robert Riches and Charles James Watts, of Norwich, impts. in the grinding and feeding apparatus of mills for grinding corn and other substances, and in the combination of such mills with flour dressing machines.

206. Jules Rovére and Hilarion Antoine Bernard Huguet, of Paris, a new electric-pile.

207. George Haseltine, of Southampton-buildings, impts. in the mode of, and means for, preserving fruit and other eatables,—a communication.

208. James Bailey, of Salford, impts. in fly or embossing presses.

209. William Woodward, Robert Woodward, John Woodward, and Adam Woodward, jun., all of Manchester, impts. in furnaces for melting metals and smelting ores.

The above bear date January 24th.

210. Thomas Steel, of Gloucester-terrace, Hyde-park, impts. in apparatus for lowering boats and disengaging them from their tackle.

211. Anthony Stevenson, of Chester, impt. in the construction of mills for grinding and pulverizing grain and other substances.

212. Richard Archibald Brooman, of Fleet-street, the manufacture of a new thread for weaving and other uses,—a communication.

213. John Marshall and Henry Mills, of Wednesbury, impts. in manufacturing ordnance and gun barrels of cast-steel or of homogeneous iron.

214. Casimir Roques, of Edinburgh, impts. in the construction of brushes used for brushing the human or other hair, and in the apparatus or means connected therewith.

215. Stephen Leedham Fuller and Arthur Fuller, of Bath, and Charles Martin, of Cheapside, impts. in the construction of carriages.

216. Otto Gössell, of Moorgate-street, impd. apparatus for adjusting the weight of railway carriages and engines,—a communication.

The above bear date January 25th.

217. William Paton, of Johnstone, Renfew, N.B., impts. in packing for steam joints, stuffing boxes, pistons, and the like.

218. David Gay, of Cheapside, impts. in photo-sculpture, and apparatus to be employed therein.

219. Charles Denton Abel, of Southampton-buildings, improved apparatus applicable to steam boilers, for preventing deposits therein,—a communication.

220. William Smith, of Taunton, impts. in machinery for compressing coal dust and other materials fit for burning, also clay into bricks, tiles, pipes, and other like articles.

221. George Haseltine, of Southampton-buildings, process of manufacturing syrup and sugar from maize and other cereal grains,—a communication.

222. John Henry Pepper, of Boundary-road, St. John's Wood, and Thomas William Tobin, of North-street, Pentonville, impd. apparatus for illusory exhibitions.

223. Stephen Sharp, of Melton-place, Euston-square, and Daniel Smith, of Brill-row, Somers town, impd. elastic valve and high-pressure and general tap.

224. Robert Mushet, of Cheltenham, impts. in lining the sides and bottoms of puddling furnaces, and other furnaces employed in the manufacture of iron or steel, and in mending, repairing, and fettling the sides and bottoms of the said puddling and other said furnaces.

225. John Harrison, of Glasgow, impts. in cleansing ships' bottoms at sea, and in the machinery, apparatus, or means connected therewith.

226. Alexander Angus Croll, of Coleman-street, impts. in the purification of coal gas.

227. Henry William Ripley, of Lightcliffe, near Halifax, impts. in coloring kempy wool and hair.

228. John Hamilton, jun., of Liverpool, impts. in machinery for propelling vessels.

229. Jacob Geoghegan Willans, of St. Stephen's-crescent, Bayswater, impts. in the manufacture of iron and steel.

230. Charles Falck, of Union-street, Clarendon-square, impts. in apparatus called ice safes.

231. William Creasy, of Bull's Hall, Bedfield, Wickham Market, Suffolk,

impts. in machinery for thrashing, beating, and dressing flax.

232. George Dibley, of Euston-road, impts. in preparing for fixing, and in fixing, plates or sheets of metal such as are used for roofing and other similar purposes.

233. John Edward Massey, of Lower Chadwell-street, Myddleton-square, impts. applicable to ship's logs and sounding machines.

234. William Clark, of Chancery-lane, impts. in pencilcases, usually termed ever-pointed pencils,—a communication.

The above bear date January 26th.

235. Johann Ernst Friedrich Lüdeke, of Stonefield-street, Islington, impts. in mathematical compasses for ascertaining the utmost correctness of the contents and square of any circle.

236. Charles Denton Abel, of Southampton-buildings, impts. in throstle spinning frames,—a communication.

237. James Hind, of Liverpool, impts. in the construction of pumps for lifting and forcing liquids.

238. Robert Helsham, of the Poultry, City, impd. instrument for removing dirt from the inside of the barrels of keys, and an improvement in the manufacture of keys.

239. John Southall, the younger, and Henry Southall, of Birmingham, impts. in the manufacture of saddle-trees, and in the spring bars of saddle-trees.

241. John Combe, of Leeds, impts. in the action and arrangement of drilling machines, turning lathes, and other machine tools, in which a variable speed is required.

243. Joseph Twibill, of Irvine, Ayr, N.B., impts. in steam generators, or steam boilers and furnaces; part of which is also applicable to other heat generating apparatus.

244. John Henry Johnson, of Lincoln's-inn-fields, impts. in the treatment of oils obtained from the distillation of tar, and in the application of the same to the purposes for which ordinary drying oils are applicable,—a communication.

245. Alexander Horace Brandon, of Paris, impts. in the treatment of tar oils, for the purpose of employing the same as paint,—a communication.

The above bear date January 27th.

246. George Haseltine, of Southampton-buildings, impd. process of manufacturing syrup and sugar from maize starch, and other cereal grain starch,—a communication.

247. Samuel Trulock, Richard Trulock, and William Trulock, of Dublin, impts. in breech-loading fire-arms.

248. Benjamin Dobson and William Slater, of Bolton, impts. in cotton gins.

249. Victor Burq, of Paris, impts. in filtering apparatuses.

250. William Edward Newton, of Chancery-lane, impts. in the rectification of alcohol, and in the apparatus to be employed therein,—a communication.

251. John Petrie, jun., of Rochdale, impts. in machinery or apparatus for washing wool and other fibrous materials.

252. John Raines, of Dukinfield, Cheshire, impts. in mortar mills, applicable also to grinding other substances.

253. William Clark, of Chancery-lane, impts. in breech-loading fire-arms and cartridges,—a communication.

254. Erastus Blakeslee, of New Haven, U.S.A., impts. in cartridge boxes for breech-loading fire-arms.

256. Alexander Septimus Macrae, of Liverpool, impts. in lanterns for burning hydro-carbon fluids.

257. William Foster, of New York, U.S.A., impts. in screw taps, more especially designed for cutting threads in the fittings and connections for gas, steam, and water pipes.

The above bear date January 28th.

259. John McInnes, of Liverpool, a metallic anti-corrosive varnish for protecting the surfaces of metals from oxidation.

260. George Davies, of Serle-street, impts. in the construction of steam engines,—a communication.

261. William Teall, of Wakefield, and Abraham Naylor, of Bradford, impts. in means or apparatus for extracting

or expressing oil or grease from the greasy waste of fibrous substances, or other substances containing oil or grease.

262. John Gibson, of the Ryhope Colliery, near Sunderland, impts. in apparatus for relieving wire ropes from strain when used in lifting and lowering weights.

263. François Alexandre Laurent and John Castlelaz, of Paris, impts. in the manufacture of benzoic acid.

264. George Carter, of Eltham-lodge, near Mottingham, Kent, impts. in the construction of caps or pots for the chimneys of dwelling houses and public buildings.

265. Cecil Henry Russell, of Old-square, Lincoln's Inn, and Joseph Needham, of Piccadilly, impts. in breech-loading guns, and in priming and capping the same.

266. Richard Archibald Brooman, of Fleet-street, impt. in shades or globes for lamps and other lights,—a communication.

The above bear date January 30th.

268. James William Gill, of Goswell-street, impd. clothes fastener, that may also be used as a letter clip.

269. Richard Archibald Brooman, of Fleet-street, impts. in rail and tramways, in laying electric-telegraph wires, and in compositions for insulating the same,—a communication.

270. William Hinkes Cox, of Bermondsey, impts. in tanning hides and skins, and in apparatus employed therein.

271. Michael Henry, of Fleet-street, impts. in apparatus for effecting locomotion or propelling on land,—a communication.

272. Thomas Hall and Samuel Bonser, of Stockport, impd. mechanism for giving intermittent or continuous revolving motion of different velocities without the use of change wheels.

273. Joseph Fletcher, of Droylsden, and Daniel Hamer, of Manchester, the application of hydro-electricity to steam, for the purpose of increasing its expansion and power; and the machinery or apparatus connected therewith; and also the application of galvano or frictional electricity for the same purpose.

274. Ewing Pye Colquhoun and John Pardoe Ferris, of Laurence Pountney-hill, City, impd. construction of lubricating apparatus for steam engine purposes.

275. Ewing Pye Colquhoun and John Pardoe Ferris, of Laurence Pountney-hill, impts. in the permanent way of railways.

The above bear date January 31st.

276. James Meakin, of Hanley, Staffordshire, mode of placing china, stone, and earthenware in saggars, ovens, and kilns, or other receptacles for firing the same.

277. John Gray, of Uddingston, Lanark, N.B., impts. in apparatus for breaking and scutching flax or similar fibrous materials.

278. Arthur Freeman, of Manchester, impts. in machinery or apparatus for folding fabrics on to card-boards, for the purpose of hot pressing.

279. John Sainty, of Burnham Market, Norfolk, impt. in lever horse hoes and lever corn drills for the hoeing and sowing of wheat and turnips and all other seed and root crops.

280. William Edward Gedge, of Wellington-street, impd. portable folding arm chair or seat,—a communication.

281. John McNaught and William McNaught, of Rochdale, impts. in machinery for washing and drying wool and other fibrous materials.

282. George Julius Vertue, of Weymouth, impts. in the manufacture of oil cake and food for animals.

283. Joseph Roper, of Birmingham, impts. in corkscrews.

284. John Moysey, of Leytonstone, Essex, impts. in coating the bottoms and sides of ships and other submerged structures, to prevent fouling and decay.

285. George Henry Pierce, of Meavy, Devonshire, impd. socket for pipes, and method of joining the same.

286. John Hughes, of Millwall, impts. in the construction of armour-plated ships, forts, and other like structures.

287. Charles Anthony Wheeler, of Swindon, impts. in fixing frost screen awnings and netting for protecting wall fruit trees, in fixing trellis for

training fruit and other trees to walls, and in bricks therefor.

The above bear date February 1st.

289. John William Gray, of Eagle Cottage, Park-road, Peckham, impd. apparatus for effecting communication between the passengers, guards, and engine-drivers of railway trains by night or by day.

290. Edwin Whittaker, of Hurst, Lancashire, enabling the passengers in railway carriages to give certain signals to the guard and engine-driver in case of danger or necessity.

291. Andrew Murray, of Lamb's Conduit-street, impts. in the manufacture of boots and shoes, and in apparatus therefor.

292. Charles Lungley, of Deptford, impts. in armour-plated ships, forts, gun carriages, and works of defence, and in fastenings to be employed therein.

293. John Maynes, of Manchester, impts. in looms for weaving.

294. James Ball, of Sheffield, impts. in the manufacture of sheep shears.

295. John Henry Johnson, of Lincoln's-inn-fields, impts. in the manufacture of ordnance and other like castings, and in the apparatus employed therein; also in carriages or moulds for the same,—a communication.

296. Julius Saunders Jeffreys, of Regent-street, impts. in armour-plated and other ships or vessels; also applicable to fortifications generally.

297. Thomas Routledge, of Sunderland, impts. in treating spent or used leys resulting from the preparation of fibrous substances used in the manufacture of paper stock.

The above bear date February 2nd.

298. William Vale, of Birmingham, impts. in the manufacture of pencil-cases.

299. Thomas Joyce, of Birmingham, impts. in breech-loading fire-arms.

300. George Hurn and Daniel Hurn, of Norwich, impts. in the manufacture of driving bands or belts for machinery and other purposes.

301. Benjamin Lewin Mosely, of Sheffield, impd. tooth-powder.

302. William Bartram, of Sheffield, self-adjusting lever powder and shot charger for fire-arms.

303. Matthew Blank, of Carlton, Nottingham, impts. in working ships' pumps.

304. William Clark, of Chancery-lane, impts. in sewing machines,—a communication.

305. John Westerby, of Mold-green, near Huddersfield, impd. apparatus for preventing the explosion of steam boilers.

The above bear date February 3rd.

306. Joseph Rideal Webb, of Hibernia-chambers, London-bridge, impd. method or process and apparatus for obtaining the concentrated extract of hops, and for preserving the same from deterioration,—a communication.

307. Frederic Row, of Colchester, impts. in the manufacture of citric and tartaric acids, and in the manufacture and treatment of citrate and tartrate of lime and analogous basic compounds; and in apparatus employed therefor.

308. James Park, of Grove-place, Brompton, impts. in clarionets.

309. Stephen Wells Wood, of Cornwall, New York, U.S.A., impts. in revolving fire-arms, and cartridges for the same.

310. John Arthur Phillips, of Earl's-court-terrace, Kensington, impts. in the purification of lead to be employed for the manufacture of white lead, red lead, and litharge.

311. Frank Clarke Hills, of Deptford, impts. in effecting the combustion of fuel in the furnaces of steam boilers and the fire-places of stoves, and of gas in gas-burners; and in apparatus connected therewith.

312. Robert Sibley Baker, of Hargreave, Northamptonshire, impts. in vermin and other traps.

313. Edouard Hottin, of Paris, impts. in rendering uninflammable cotton, silk, and other textile fabrics.

315. Richard Archibald Brooman, of Fleet-street, impd. varnish for preserving wood, and for protecting iron ships and other metal work from oxidation and from fouling,—a communication.

316. James Lyne Hancock, of Gos-

well-road, impts. in cushions for billiard and other like tables.

317. Arthur Henry Robinson, of Dublin, impts. applicable to air cushions, mattresses, portable baths, and other like air-inflated articles.

318. Robert Richardson, of Great George-street, Westminster, impts. in railway chairs, fastenings, and sleepers.

319. Robert Morellet Alloway, of the Strand, impts. in treating or manufacturing peat for fuel, and in apparatus for the same.

320. William Edward Newton, of Chancery-lane, impts. in the preparation of superphosphate of lime,—a communication.

The above bear date February 4th.

322. Jabez Booth, of Manchester, impts. in the manufacture of paper-hangings.

323. Edward Williams and Thomas Williams, of Miles-Platting, near Manchester, impts. applicable to spinning mules and throstles.

324. William Henry Latham and Frederic Cartwright Ward Latham, of Bolton, Lancashire, impd. machine for trimming or cutting the edges of books, magazines, and such like articles.

325. Richard Archibald Brooman, of Fleet-street, impts. in hair pins,—a communication.

326. Robert Shaw, of Attercliffe, near Sheffield, impts. in window safes for the protection of property.

327. George Duncan, of Liverpool, impts. in machinery or apparatus for forming certain parts of metallic casks and drums.

328. Alexander Steven, of Glasgow, impts. in hydraulic lifting or hoisting apparatus.

329. William Cockburn, of Paisley, impts. in, and connected with, Jacquard apparatus for weaving.

330. Anatole Auguste Hulot, of Paris, typographic ink.

331. John Isaac Watts, of Keevil, near Trowbridge, impts. in obtaining motive power.

332. Charles Beard, of Bury St. Edmund's, impts. in apparatus for ventilating horticultural and other buildings.

333. William Pickford Wilkins, of Ipswich, impts. in mills for grinding wheat and other grain.

The above bear date February 6th.

335. Constantine Henderson, of Parliament-street, impts. in the construction of roadways, pavements, and iron girders; specially applicable for the purpose of constructing roads, pavements, bridges, and all description of buildings.

336. Henry Bernoulli Barlow, of Manchester, impts. in machinery for breaking the stems of, and preparing, flax, hemp, and other fibrous substances,—a communication.

337. Raymond Brassens, of Bordeaux, and François Alexandre Le Mat, of Paris, impts. in ships and vessels.

338. Charles Lungley, of Deptford, impts. in steam engines.

339. Alice Isabel Lucan Gordon, of Prince's-gate, Hyde-park, impts. in candlesticks and candle-holders.

340. John Cornes, of Ilford, and William Simpson, of Chilton-house, Rosherville, near Gravesend, impd. machinery for cutting, sifting, separating, bruising, sacking, preparing straw and other vegetable fibrous substances to be employed in the manufacture of various kinds of paper, and also for preparing food for cattle.

341. Charles Kilburn, of Richmond, impts. in the construction of life-belts, swimming-belts, jackets, and buoys; and in the employment and utilization of certain materials in the manufacture of the same.

344. William Sim, of Glasgow, impd. method of, and impts. in apparatus for, extracting gases from mineral oils, and employing the same for illuminating purposes.

345. Jake Lake, of Devonport, impts. in steam generators.

346. Raphael Brandon, of Regent-street, impts. in cannon shot and shells.

347. Alfred Augustus Larmuth, of Salford, impts. in healds for looms, and in machinery or apparatus for manufacturing and winding the same upon shafts.

348. William Edward Newton, of Chancery-lane, impd. apparatus

for separating grain,—a communication.

349. George Twigg, of Birmingham, impts. in fastenings for stay busks, leggings, gaiters, and other similar articles.

350. Samuel Egan Rosser, of Dorset-street, Salisbury-square, impts. in the ventilation of pressing irons heated by gas, and for preventing the condensation of the vapour in the tubes or flues leading therefrom.

The above bear date February 7th.

351. Charles Field, of Old North-street, Red Lion-square, method (or mechanical contrivances) for lacing and fastening ladies' stays, (sometimes called corsets and bodices).

352. William Edward Wiley, of Birmingham, impts. in pencil holders and pen-holders, and in holders for crayons and other marking, writing, or drawing materials.

353. Richard Clarke Thorp and Philip Young, of Barnsley, Yorkshire, impts. in the miner's safety lamp.

354. Jules Desmontils, of Paris, impts. in the manufacture of grease for lubricating purposes.

355. Julius Singer, of Watling-street, City, impts. in garments for ladies', gentlemen's, and children's wear.

356. William Anderson, of Dublin, impd. mode of making metal pipes.

357. Alfred Warn Banks, of Newgate-street, impd. signal, applicable to railways, ships, telegraphs, and other such like purposes.

358. Edward Lindner, of Vienna, impts. in breech-loading fire-arms.

359. George Elliot, of Betley Hall, Staffordshire, and Henry Coxon, of Sunderland, impts. in apparatus for discharging coals and other cargo from ships' holds; applicable also to the raising and transferring of weights from one point to another.

360. Richard Archibald Brooman, of Fleet-street, impd. machinery for the manufacture of wire and other netting,—a communication.

361. William Staats, of Cannon-street West, impts. in the manufacture of skirt borderings and linings to be applied to wearing apparel,—a communication.

The above bear date February 8th.

362. William Alfred Marshall, of Leadenhall-street, improved insulating material for telegraphic and other purposes, together with an improvement in protecting telegraph wires, especially applicable to submarine and subterranean telegraphs,—a communication.

363. John Cornelius Craigie Halkett, of Cramond Iron Works, Mid-Lothian, impts. in protecting wooden surfaces from the fouling and injury to which they are ordinarily liable in sea-water.

364. John Chubb, of St. Paul's Churchyard, impts. in iron safes and strong rooms.

365. Moses Bier, of Great Tower-street, City, impd. machinery or apparatus for propelling boats, ships, vessels, or other floating craft and objects.

366. Richard Winder, of Abingdon-street, Westminster, impts. in the mode of ploughing and performing other like operations upon the land by steam power.

367. Milo Peck, of New Haven, U.S.A., impts. in the manufacture of patched balls for fire-arms.

368. John Parker Lindsay, of New Haven, U.S.A., impts. in locks for fire-arms.

369. George Edward Meek, of Crane-court, Fleet-street, and William Howes Howes, of Curtain-road, Shoreditch, impts. in fastenings for doors, windows, drawers, and other like purposes.

370. Alfred Vincent Newton, of Chancery-lane, impd. mechanism for operating the working parts of sewing machines,—a communication.

371. John Dale, of Manchester, impts. in the production of substances to be used in place of the pigment usually termed satin white.

The above bear date February 9th.

372. Alfred Krupp, of Essen, Prussia, impts. in breech-loading ordnance.

373. Charles Lingard, of Sheffield, impts. in the manufacture of scissors, shears, and edge tools,—partly a communication.

374. Evan Leigh, of Manchester, impts. in furnaces for smelting iron ores, commonly called blast furnaces, also

in cupolas used in foundries for rendering down or melting iron or other metals.

375. John Ramsbottom, of Crewe, impts. in machinery for rolling and hammering iron and other metals.

376. Edward Lord, of Todmorden, impts. in machinery for preparing cotton and other fibrous substances.

377. Rowland Gibson Hazard, of South Kingston, Rhode Island, impts. in looms for weaving.

379. Herbert William Hart, of the Strand, impts. in apparatus for affixing postage and other gummed stamps and labels.

380. William Edward Newton, of Chancery-lane, impts. in the formation of embankments, sea-walls, breakwaters, and other similar constructions,—a communication.

381. George Coles, of Gresham-street West, and James Archibald Jaques and John Americus Fanshawe, of Tottenham, impts. in the manufacture of boots, shoes, and other coverings for the feet.

The above bear date February 10th.

383. Jacob Schneuhr, of St. Petersburg, impts. in apparatus for counting coins of money, tickets, and other similar articles, and indicating the number thereof.

384. David Henry Barber, of Cambridge, Washington County, U.S.A., impts. in reaping machines; parts of which impts. are also applicable to mowing machines.

385. George Carter Haseler and John Bush Haseler, of Birmingham, impts. in the manufacture of brooches; part of which said impts. are applicable to the manufacture of lockets.

387. Charles Atherton and Amherst Hawker Renton, of Whitehall, impts. in buoys, beacons, floats, or pontoons; which impts. are also applicable to floating bodies generally.

388. Joseph Hall, of Nottingham, the manufacture or production of oil for the use of machinery, or for other similar purposes.

390. Andrew McLaren, of Upper Thames-street, impts. in apparatus for heating water, and in connecting hot-water and other metal pipes.

391. William Crookes, of Wine Office-court, Fleet-street, impts. in extracting and separating gold and silver from their ores or matrices.

392. Charles West, of Queen's-place, Kennington-park, impts. in apparatus for giving alarms.

394. Edward Jacob Hill, of Ferryside, Kidwelly, South Wales, impts. in pen and pencil holders.

395. John Cass, of Accrington, impts. in furnaces and boilers, and parts connected with them, for generating steam and heating fluids; and also impd. apparatus for reducing and shutting off steam, and regulating the speed of steam engines.

396. Alfred Vincent Newton, of Chancery-lane, impts. in the construction of single-thread sewing machines,—a communication.

397. Henry Houldsworth Grierson and John Macvicar Rigby, of Manchester, impts. in cupolas and blast furnaces.

398. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in the manufacture of caoutchouc,—a communication.

The above bear date February 11th.

400. Henry Martyn Kennard, of Crumlin, near Newport, impts. in machinery for rivetting, and for making rivets.

401. Robert William Thomson, of Edinburgh, impts. in steam boilers.

402. Louis Henri Gustavus Ehrhardt, of Richmond-road, Bayswater, impd. gunpowder.

403. Jean Antoine Pastorelli, of Marseilles, impts. in extracting turpentine and tar from resinous wood.

404. William Adams, of Bow, impts. in bogie trucks used for supporting railway locomotive engines, carriages, and waggons.

406. Francis Charles Vannet, of Paris, impts. in the manufacture of penholders.

407. Edward Brown Wilson, of Glasgow, impts. in fire-places.

408. Edward John Cowling Welch, of Harrow, impd. apparatus for supplying with a constant and regular pressure air to burners for consuming or burning hydrocarbons, for illuminating purposes.

The above bear date February 13th.

410. James Gresham, of Manchester, impts. in, and applicable to, that and similar apparatus for raising and forcing fluids, and feeding steam boilers, known as Giffard's injector.
411. Herbert John Walduck and Edward Barton, of Manchester, impts. in furnaces for smelting or reducing ores, and for melting metals.
413. George Harton, of Kentish-town, impts. in waterproofing skins, hides, and leather.
414. William Conway Hine, of Swineshead, Lincolnshire, impts. in stoppering bottles or other similar vessels, and measuring quantities therefrom.
415. William Fothergill Batho, of Birmingham, impts. in expansion gear for steam-engines.
416. Robert John Jones, of Blue Pits, near Rochdale, impd. system of manufacturing clog soles, patten boards and similar articles by machinery.
417. George Whitton, of Kingston-upon-Hull, impts. in hydraulic presses.
418. Alfred Fryer, of Manchester, impts. in the mode of treating, for evaporating and concentrating purposes, cane juice and saccharine, and other solutions and liquids; and also in machinery or apparatus for the concentration of cane juice and saccharine and other solutions, and for the evaporation of liquids.
419. Edwin Henry Newby, of Cheapside, impts. in the manufacture of cast and wrought iron,—a communication.
420. John Trotman, of Cornhill, impts. in mooring anchors.

The above bear date February 14*th.*

New Patents Sealed.

1864.

2050. J. J. Parkes.
2057. E. H. Waldenstrom.
2062. Friederich Kreuz.
2063. Julius Thomson.
2067. John Walker.
2068. Franz Feichtinger.
2071. C. W. Harrison.
2072. Francis Taylor.
2073. James Allan.
2074. B. W. Barwick and W. Hartley.
2077. R. M. Black.
2079. J. E. Grisdale.
2082. George Parsons.
2086. William Spence.
2089. E. T. Bellhouse and W. J. Dorning.
2095. R. Beard and W. Downing.
2099. N. J. Peton.
2100. R. A. Brooman.
2101. George Davies.
2102. G. H. Cottam and H. R. Cottam.
2107. M. L. Muller.
2110. Edmund Hunt.
2112. Richard Marshall.
2114. E. Calvert and T. Edmeston.
2116. P. A. le Comte de Fontainemoreau.
2119. Joseph Cheetham.
2120. William Rowden.
2121. F. W. Armitage.
2127. John Packer.
2129. John Shanks.
2130. William Clark.
2133. C. W. Harrison.
2135. William Bullough.
2136. A. E. Peirce.
2139. J. B. Andreux and E. Coulon.
2141. Sir John Macneil.
2145. Thomas Wilson.
2146. John White.
2150. Thaddeus Fowler.
2153. J. H. Wilson.
2158. A. M. J. Count de Molin.
2159. P. M. Parsons.
2160. Margaret Barland.
2161. R. A. Brooman.
2162. W. W. Burdon.
2163. J. Ivers and T. Ogden.
2168. T. E. Symonds.
2170. E. R. Lloyd and S. Lloyd.
2171. E. R. Lloyd and S. Lloyd.
2173. M. A. F. Mennons.
2177. David Walker.
2178. T. H. Baker.
2179. John Smith.
2181. W. H. Perkin.
2190. P. E. Placet.
2192. J. S. Crosland.
2194. Thomas Taylor.
2195. George Bedson.
2196. A. V. Newton.
2197. Daniel Fruworth.
2199. Thomas Wilson.

2203. H. D. P. Cunningham.
2204. H. C. Löbnitz.
2205. Thomas Restell.
2207. P. W. Barlow.
2214. T. D. Ridley.
2215. Joseph Holding.
2219. Cornelius Moriarty.
2220. Alexander Watt.
2225. D. C. Knab.
2226. George Clark.
2232. E. Higham and R. Kirk.
2234. J. M. Fisher.
2235. A. C. Kirk.
2236. J. H. Ritchie.
2237. Z. S. Durfee.
2239. Benjamin Glover.
2244. J. H. Johnson.
2247. J. E. Morris.
2248. Richard Townsend.
2253. A. M. Perkins.
2258. J. G. Hey.
2260. J. H. Simpson.
2264. Robert Holt.
2274. Charles Brown.
2275. M. D. Jeffreys.
2277. Richard Chrimes.
2278. Frederick Yates.
2280. James Adams.
2283. Richard Richards.
2286. Dominique Tamet.
2288. Joseph Smith.
2294. R. A. Brooman.
2295. R. W. Sievier.
2297. C. F. M. Jessen.
2298. William Laurence.
2299. M. A. F. Mennons.
2302. Stephen Bates.
2304. W. P. Struvé.
2305. William Clark.
2307. C. W. Howell.
2309. Henry Rogers.
2310. Edmund Smith.
2314. J. L. Courcier.
2315. E. T. Hughes.
2316. George Scott.
2323. Samuel Laing.
2324. F. L. M. Dorvault.
2325. G. G. Bussey.
2327. Isaac Watts.
2328. John Clark.
2329. T. Walker and T. F. Walker.
2331. E. R. Handcock.
2333. Peter Barr.
2335. B. W. A. Sleigh.
2336. Michael Henry.
2337. Henry Vale.
2338. W. B. Woodbury.
2339. William Palmer, jun.
2340. J. H. Kidd and J. C. Mather.
2341. A. V. Newton.
2343. John Todd.
2344. Henry Bridgewater.
2347. A. H. P. S. Wortley and W. W. Vernon.
2355. P. A. le Comte de Fontainemoreau.
2362. William Clark
2374. J. C. Wilson.
2376. Horace Forbes and Hugh Forbes.
2379. Thomas Powell.
2383. Jean Jongen.
2385. Nathan Thompson.
2404. W. F. Henson.
2424. William Clark.
2430. W. S. Cowles.
2431. G. T. Bousfield.
2437. George Haseltine.
2445. Charles Greenway.
2452. Hezekiah Conant.
2453. Thomas Brown.
2461. William Anderson.
2485. William Gardiner.
2504. Hiram Tucker.
2530. Joseph Bathin.
2539. J. H. Dallmeyer.
2547. James Hayes.
2548. W. E. Newton.
2578. William Clark.
2604. François Martin.
2612. G. E. Donisthorpe.
2615. Richard Hornsby.
2618. Henry Bird.
2623. Westley Richards.
2642. G. E. Donisthorpe.
2648. J. E. F. Ludeke and D. Wilkens.
2690. J. Solomon and A. G. Grant.
2702. Isaac Schwartz.
2784. James Thompson.
2843. N. Bailly, C. Duraud, G. H. Mesnard, and Z. Porier.
2860. J. Gothard and H. Garland.
2885. William Clark.
2929. P. Haggie and P. Gledhill.
2970. Robert Maynard.
2995. Thomas Harris.
3019. George Haseltine.
3029. W. E. Newton.
3092. C. Hancock and S. W. Silver.
3093. C. Hancock and S. W. Silver.
3094. C. Hancock and S. W. Silver.
3110. C. Hancock and S. W. Silver.
3146. Sir John Gray.

1865.

19. Edward Keirby.
54. Horatio Ames.
123. A. V. Newton.
152. W. E. Newton.
200. W. E. Newton.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications*

NEWTON'S

London Journal of Arts and Sciences.

No. CXXV. (NEW SERIES), MAY 1ST, 1865.

ROBERT STEPHENSON, THE ENGINEER.*

AMONG the many inventions which posterity will have to ascribe to the present age, is one that we fear will do us little credit—viz., memorial literature. There has always existed in the human mind a desire both to acquire and to hand down to future generations a knowledge of the men who have played a prominent part on the world's stage; and through that desire we are possessed of biographical sketches which are now deemed invaluable; but the love of posthumous fame which induced the kings of Egypt to build their monstrous pyramidal tombs, appears to actuate the friends of modern celebrities to provide for them literary shrines of the like proportions. In the work before us, we recognize an example of this memorial literature, to which an artificial value is imparted, by the insertion of essays on engineering subjects from the pen of Professor Pole. These essays, as arranged by Mr. Jeaffreson, form no integral part of "the life" of the great engineer, but are literary panoramas, and have about the same connection with the rest of the work as the beautiful moving panoramas of Stanfield (which we remember to have seen, some thirty years ago) had with the pantomimes with which they were associated. Apart from Mr. Pole's papers, which are valuable contributions to science, there is nothing said in Mr. Jeaffreson's two octavo volumes that would not have been better said in the space of one number of this Journal. The career of Robert Stephenson, the celebrated civil engineer, as there described, was one conspicuously barren of exciting incident, and by no biographer—excepting, perhaps, old Isaac Walton—could a sustained interest have been created for the unscientific reader from such unpicturesque materials. In the first place, Robert Stephenson's professional career

* "The Life of Robert Stephenson, F.R.S," by J. C. Jeaffreson, Barrister-at-Law, with descriptive chapters on some of his most important professional works, by William Pole, F.R.S. Longmans.

was one continued success, commencing from a very early age, and due, in great part, to the position in which his father was enabled to place him. Again, the contests into which his prominent position led him to engage, were purely of a professional character, and therefore, to a very small extent, appreciable by the general public, and these contests were chiefly undertaken against his personal friends, and were carried on without disturbance to the bonds of amity. They therefore lacked the excitement which so often makes partisans of indifferent spectators, and enlists the sympathies of readers. Yet, for all this, it is well that his life is thus elaborately written, for it puts before the world facts which, being accessible to all, will effectually restrain, in his case, those tendencies, which are too prevalent, to carry into the realms of romance our pioneers in practical science.

Robert Stephenson, the only son of George Stephenson, the brakesman of the Dolly Pit engine at Black Callerton (who could neither read nor write at the age of eighteen years), was born October 16th, 1803, at Willington Quay, some six miles from Newcastle, and at his christening, his relatives described him as "a wee, sickly bairn, not made for long on this earth." In fact, he inherited from his mother a tendency to consumption, which carried her off before he was three years old. The residence of George Stephenson was short at Willington, for his ability was already beginning to be known, and he moved thence to West Moor Colliery, Long Benton, where he resided till he made rapid strides to opulence and fame. At the village school, young Robert was initiated into learning, and with the advice of his father to "mind the buiks," made, we must presume, the ordinary progress. When twelve years of age, he was sent to a day-school at Newcastle, where his uncouth appearance and "guttural pit-intonation," are said to have provoked some playground satire. In the evenings he was kept by his father to his books, or his attention was directed to mechanical contrivances. But, notwithstanding this paternal care, he gave no signs of future superiority. In the year 1819 he was apprenticed, for three years, to Mr. Nicholas Wood, the mining engineer, and then the viewer of Killingworth and adjacent collieries. This kind of life was by no means suited to Robert's delicate constitution, but, before the expiration of his term, he was engaged, with his father, in surveying the route for the Stockton and Darlington Railway, in which Mr. N. Wood became interested, with his father and Mr. Pease, his early and staunch friend. In 1822 Robert studied, for one term, at the University of Edinburgh, where he got an insight into practical geology, and made the acquaintance of Mr. G. O. Bidder. The pecuniary successes of the father enabled him, with the assistance of friends, to establish at Newcastle, in the year 1823, the manufactory, which has since become

famous for the building of locomotive engines; and here the son was installed as manager. A tempting offer was, however, soon after made to the young engineer to accompany a mining expedition to South America. The salary offered was £500 per annum, but, besides this, the advantage of a residence in a milder climate was not without its influence. The project was strongly opposed by his father, but he eventually yielded to his son's wishes in the matter, and Robert engaged himself for three years, to the Columbian Mining Company, as engineer in chief of an expedition which appears to have proved a total failure. Heartily sick of his expatriation, he returned to England in 1827, having met Trevithick the engineer, stranded at Carthagena, and from whom he perhaps obtained valuable hints in relation to locomotive engines. The vessel in which Stephenson embarked was bound for New York, and during the voyage they rescued two shipwrecked crews, and were themselves wrecked before reaching their destination. Arrived in New York, he determined, in company of some friends, to make a pedestrian journey to Montreal. Returning from thence to New York, he took ship for Liverpool, and found his father settled there and engaged on the Liverpool and Manchester Railway. If he had not gained pecuniarily by this overture, Robert Stephenson could not surely have regretted his residence abroad, for, according to our author, in the three years spent alternately among unmanageable Cornish miners, and in society where "from high to low, the bribe and the dagger were regarded as necessary elements of political existence," he "had changed from a raw Northumbrian lad into a polished gentleman."

Returned to England, he again associated himself with his father's pursuits, and directed his attention to improving the locomotive engine; and in due time he completed the "Rocket," which established the practicability of working railways by locomotive engines. That the labours of both father and son in this direction were very meritorious, there can be no doubt, but to ascribe to them the honours of inventors is simply ridiculous. Their minds were of a very different order: their merit lay in being great observers, and in never failing to apply what they had once learned.*

In 1828, Robert Stephenson was engaged on the Canterbury and Whitstable Railway, which brought him in close proximity with London, which offered an attraction of a special kind. The result of this attraction was, that the bells of Bishopsgate Church rang for his marriage in June of the following year. In 1830 occurred the great triumph of the father—the opening of the Liverpool and Manchester

* By reference to the patent list, we find that George Stephenson appears five times between the years 1815 and 1846 as an inventor; and Robert six times between the years 1826 and 1841. Their subjects were limited to locomotive engines, carriages, and railways.

Railway, and the successful working thereon of the engines of the Newcastle firm. The same year also saw the little Kent line of railway opened, and at this time Robert began to undertake engineering works on his sole responsibility. But notwithstanding his rapid professional advancement, he was so far from being intoxicated with success, that in conversation with a friend at this time, he is reported to have said, "My courage at times almost fails me; and I fear that some fine morning my reputation will break under me like an egg-shell." There was, however, no cause for fear, as events quickly proved.

The success of the Liverpool and Manchester Railway created a strong desire to connect the metropolis by railways with the principal towns of England. Of the many schemes which soon arose, that for making a railway between London and Birmingham was the first. George Stephenson was nominally entrusted with preparing surveys for this line, but the labour devolved on the son, who was eventually appointed the engineer-in-chief for this great undertaking. The parliamentary opposition which awaited the promoters, served both to delay the work and to dispirit the young engineer, but the rejection of the bill in 1832 drew from Lord Wharncliff, one of his father's early patrons, and the chairman of the committee which determined its fate, the following remark, in allusion to Robert Stephenson's evidence on the bill in committee, "My young friend, don't take this to heart. The decision is against you, but you have made such a display of power, that your fortune is made for life." In the following session, however, by dint of bribing the landowners, the projectors were enabled to get their bill through Parliament. The masterly way in which this leading railway was carried out, at once placed its engineer in the first rank; and it would have been well for the company if, instead of stopping short at Euston-square, they had followed his advice and pushed the line up to Waterloo-bridge. This being the first work in which the line was let out in large portions to contractors, many were the failures among those adventurers, whose comparative inexperience led them into grievous miscalculations. So great, however, was the confidence placed by both the company and the contractors in the integrity of the engineer, that, by common consent, he was appointed sole arbitrator of the disputes which arose on the liability of the contracting parties.

We have said that Robert Stephenson's career was an unchequered one, but there was one piece of preferment which, by falling to his lot, threatened to overwhelm him. This was his appointment as engineer to the Stanhope and Tyne Railway. This railway was constructed on the way-leave principle, the landowners receiving rent from the company for the use of their land; and each shareholder being liable for the debts of the company, from no act of incorporation being sought or required.

For his professional labours, Robert Stephenson received payment in shares, and, through gross mismanagement of the company's affairs, the scheme proved a financial failure. To relieve themselves, the shareholders determined to dissolve and reconstruct the company, and, under the powers of an Act, to raise a sufficient capital to pay off all debts, and work the line in a better manner. A sum of £20,000 fell to Stephenson's share to pay, but eventually this unpromising speculation proved a satisfactory investment.

Although work now poured in upon him, he found time to advise on foreign railways, and, for this purpose, visited Brussels with his father in 1835, and again in 1837, when the railway between Brussels and Ghent was opened. In this year he appeared before a parliamentary committee, to support a projected line between London and Brighton, but, after a tough struggle, his line was rejected in favour of that of Sir John Rennie. Into his inner life his biographer gives us little insight, and it is, perhaps, as well, for, when touching upon his social life, he is prone to exaggerate. Mr. Jeaffreson speaks of his "taking a conspicuous position in London society," as if he were some eastern potentate, and also of the attention he received in early life from Liverpool matrons who possessed marriageable daughters, &c. Being an early riser, he secured two hours of study before breakfast; and, though his reading was chiefly scientific, he did not quite neglect poetry. The electric telegraph quickly attracted his notice, and he was not slow to appreciate its value. He first applied it to working the traffic at Camden Town; and as his father foresaw the demand for locomotives, and determined on their manufacture, so the son foresaw the demand that would arise for telegraphic communication, and became pecuniarily interested in the development of that system. Before the completion of the London and Birmingham line, he was called to the continent to advise on projected railways, and to give them a general superintendence, and he was created a Knight of the Cordon of Leopold for his services in Belgium. This honour, whatever it might be worth, came, however, very inopportunely, for it was valued by the receiver only for his wife's sake, and a lingering disease brought her to the grave in October, 1842. He thus lost, as he expressed it, "half his power of enjoying success." This will, perhaps, explain why, when offered knighthood, at a later period, at the hands of his Sovereign, he declined it.

The great work which stamps Robert Stephenson as the first engineer of his day is the Chester and Holyhead Railway, the act for which was obtained in 1844. In this line occur, as is well known, the Conway and the Britannia Bridges, which are monuments of engineering skill. They may be said to have had their origin as much in the failure of the Dee Bridge, which broke under a passing train, as in the exigencies of

the situation. Wrought-iron tubes, of size sufficient to receive a passing train, are here held in mid-air, and so secured as to suffer little or no deflection under such a strain This miracle of ingenuity is great enough to make a dozen reputations; and credit may well, therefore, be awarded to Mr. William Fairbairn, who claims to be the inventor of the tube. While this stupendous work was proceeding, Stephenson was engaged in what is known as the Battle of the Gauges, and he succeeded in pressing on the legislature the importance of an uniform width of railway track throughout the country. This view was confirmed by an act, dated August 18th, 1846. About the same time he was engaged in another important controversy, respecting the merits of atmospheric propulsion on railways, of which he was an uncompromising opponent. A most interesting essay on this subject is given by Mr. Pole, who, in commenting upon the favourable report of a Committee of the House of Commons, appointed to investigate, once for all, the merits of the plan, says: "This official recognition of the merits of the system forms the culminating point of its history; for, strange to say, from this event we have only to trace its continual decadence, and, within but a few years afterwards, to chronicle its abandonment."

Robert Stephenson having now acquired a European fame, received frequent professional invitations to the continent. In 1845 he visited Italy, and in the next year Norway, where he designed a railway for connecting Christiania with the Mïosen Lake. But, at this time, he had on hand work enough at home to satisfy most men. While the Chester and Holyhead Railway was yet unfinished, the Newcastle and Berwick, and the Trent Valley lines, claimed his attention; and, as if this were not sufficient to employ his active mind, he was invited to represent Whitby in parliament, and was elected in July, 1847, member for that borough; which honour he retained—though not without opposition—until his death. Being no heaven-born orator, he took no prominent position in the House; but, when occasion offered, he made known his views on subjects kindred to his profession. As a politician he was an "impracticable," for it is clear that, to him, the first principles of political economy were unknown, and his views of legislation were of the old school. After the completion of the great engineering works in the North of England, which he had undertaken, he began to decline business, escaping earnest solicitations by embarking in his yacht, the "Titania," for foreign countries. But as a pleasure trip to Norway had led him to undertake the Christiania Railway, and drew him there again in the autumn of the years 1851-2-4, and finally at the opening of the railway in 1859—so a voyage of pleasure to Egypt, in 1850, ended in his planning a railway between Alexandria and Cairo, which was com-

pleted and opened in 1856. The success of the Britannia Bridge induced the directors of the Grand Trunk Railway of Canada to seek the assistance of Robert Stephenson in crossing that formidable stream the St. Lawrence. In August, 1853, he visited Canada, to inspect the point of crossing and mature his designs. The result of this visit was the Victoria Bridge, which measures 6650 feet in length, and was erected under the superintendence of Mr. Alexander Ross. It is at once a masterpiece of engineering skill and daring, and a miracle of colonial enterprise. From the number of great works with which his name is associated, it is manifest that he must have been very efficiently aided by his resident assistant engineers; this service he could not fail to secure, by the generosity of his disposition, which made him rather an adviser than a dictator; and in his will he acknowledged his obligations by a substantial legacy to his coadjutors.

In the year 1856 Robert Stephenson was elected to the presidential chair of the Institution of Civil Engineers, which society he had joined in 1830. When delivering his presidential address, he took occasion to expose, in a most masterly way, the iniquities of railway legislation, and he traced from that source the depreciation of railway property. In the following year, he received from the University of Oxford the honorary degree of D.C.L. Failing health now brought upon him fits of melancholy, which he could only dispel in congenial society. He spent much time in his yacht, visiting places in the Mediterranean, in search of recreation and of a genial climate. That of Egypt he describes as "intoxicating him with delight." His last winter he spent there with his friends Mr. and Mrs. Brunel, and returned temporarily benefitted by the change. During the following summer, though he mixed with society as usual, he no longer maintained his accustomed cheerfulness. Desirous of joining in the festivities at Christiania, on the occasion of the opening of the Norwegian Railway, he once more embarked in the "Titania," in August, accompanied, amongst other friends, by Mr. Bidder, who had assisted him in constructing the railway; and, after attending a banquet given in his honour, he returned to England to die. On the 12th of October, Robert Stephenson breathed his last at his house in Gloucester-square, and he was buried in Westminster Abbey, attended by a concourse of mourners that spoke volumes as to his worth.

Before closing this notice of the life of Robert Stephenson, we must say a word respecting Professor Pole's essays. They are five in number, and relate to the atmospheric railway controversy, to iron bridges in general, the Britannia Bridge, the High-Level Bridge, Newcastle, and the Victoria Bridge. Some of these subjects required delicate treatment, by reason of the conflicting interests concerned; but,

notwithstanding this, all have been admirably treated, and will well repay a careful perusal, supplying as they do, for the ordinary reader, the place of the more elaborate treatises or scattered details from which the facts are drawn, and giving, moreover, the writer's opinion on the points discussed.

COAL: ITS MANNER OF FORMATION AND ITS COMPOSITION.

Article III.

Thus far we have endeavoured to show the probability, at least, of the theory that our great coal deposits may have resulted from the growth and decay of minute aquatic plants of the confervoid kind; we will now offer our proofs that this theory agrees, not only with the constitution and arrangement of the coal deposits themselves, but also with the chemical composition and habitude of such of the confervoid race of plants as yet remain in this country, and may be supposed to represent the extinct class which, under a very different climate, originated our enormous accumulations of fuel. The all-observing eye of Shakspeare has not failed to notice the humble object to which we are about to direct attention: in King Lear he speaks of "the green mantle of the standing pool." This "green mantle" and "standing pool" represent in few words, and on a microscopic scale, our idea of the origin of coal. The green mantle is composed of minute confervoid plants, and these are coated with a waxy covering that not only protects them from the injurious action of the water, but enables them to swim on its surface, until, from the increase of their internal structure, they become too heavy; when they sink to the bottom of the pool, and, like a carpet, cover uniformly every undulation and irregularity of the solid surface. We have been informed by a reliable authority that, in the marshy districts of Jamaica, these "green mantles" form and fall during the course of a single day, or even more frequently; but in this country, during the hottest weather, we have not observed them to form and subside oftener than once in three or four days. We have, however, repeatedly collected them, and been astonished at the great rapidity of their reproduction, as well as the singular nature of the chemical results which they have yielded, and which we will now briefly describe. A quantity of these green mantles was gathered and slightly compressed into a mass, which weighed 6¼lbs.; this was spread out to dry in an air-stove, kept at a temperature of 140 Fahr. After 48 hours' exposure it ceased to lose weight, and then weighed almost exactly ½ a lb.; consequently, the amount of mechanically-held water lost by drying was about 92 per

cent. The dried residue had now a dark olive-green colour, and could be bent, twisted, and cut with a knife like a piece of leather. It was first digested in ether until it ceased to give a green tint to this fluid, after which it was boiled in alcohol so long as anything could be thus extracted from it. The two solutions were then mixed together and distilled in an alembic until nearly the whole of the fluid had passed over. The remainder was now washed out of the alembic by hot water, and the whole left to cool in a basin. When cold, the surface of the water was found to be covered with a thick coating of solid unctuous matter, of a bright green colour, which, on being separated from the water and dried over sulphuric acid, *in vacuo*, weighed exactly 27 per cent. of the original weight of the dried residue. By the application of chemical re-agents, it was distinctly demonstrated that this unctuous matter consisted of wax, resin, oil, and green colouring or chlorophylle; but as our present inquiry relates solely to its ultimate composition in connection with coal, we proceed at once to exhibit the analytical constitution of this unctuous compound. It consisted of

Carbon	75·4
Hydrogen	8·8
Oxygen and Sulphur	12·7
Nitrogen	3·1
	100·

The existence of sulphur in the compound was proved by the action of nitric acid upon it, which produced an appreciable amount of sulphuric acid; but the quantity was not determined, because it was found impossible altogether to destroy the unctuous matter by the agency of nitric acid, however long the action was continued. Nevertheless, enough is here shown to prove that the dried residue of existing confervæ or Shakspeare's "green mantle," contains 27 per cent. of a compound greatly resembling coal in composition, and as it is almost certain that the atmospheric conditions which prevailed during the coal formation must have been extremely humid and rainy, we may readily conclude that the confervæ then existing were even better supplied with a protective coating than those which we have examined; in other words, that they would possess a larger proportion of unctuous matter, and that this would be of a most resisting or waxy nature.

Many geologists have been much surprised at the manner in which coal strata generally follow with the most minute exactness every hill and hollow, every inequality or irregularity in the form of the bed, or fundamental rock upon which they rest; this, in fact, has led many observers to conclude that the coal itself must have once been in fusion; for it is quite impossible to conceive that solid wood can ever have been so compressed as to force its way into crevices and

cavities such as we sometimes find filled with coal, and which crevices are occasionally many miles in length and breadth, and yet not thicker than a sheet of paper. But we have already shown that the production of this thin sheet of coal might easily happen as a natural consequence of the green mantle theory, and that it would take on like a carpet exactly the form of the surface upon which it rested—its thinness or thickness representing in reality nothing but the rapidity with which the shale-forming inundations had succeeded each other. Moreover, geologists have been unable to explain the established fact, that whilst abundant remains of large plants, reeds, bamboos, ferns, &c., exist in the shale and surrounding strata, few or none are ever found in the coal itself. But if, as we have supposed, the deposition of matter to form coal took place in a calm, undisturbed lake, an immense "standing pool," then no large plants could mingle with that matter; whereas, the surrounding shale, being the result of disintegrated felspar brought from a distance by a casual but tempestuous flood, it is evident that this flood would tear up and bring with it many large plants, which would settle down with the disentegrated felspar or mud as soon as the motion of the water ceased by entering a large lake: thus, a bed of coal might be covered by a layer of shale containing many large plants, having no connexion whatever with the coal, either as regards its origin or chemical composition. If, again, we suppose such a flood or torrent to have entered upon a shallow lake already partially filled up by accumulations, then the more recent "green mantle" deposits would be torn up, especially at the point of entrance of the torrent, and being commingled with the mud, would settle down in more tranquil situations, and thus constitute a layer of bituminous shale: hence it is that bituminous shale is never found in the deep or anthracitic strata, and that its composition is as variable as its accidental formation would lead us to expect. Viewed in the same light, it is easy to understand why shells, which are chiefly of the fresh-water muscle, or mytilus kind, exist in some few of the coal shales, and are never found in the coal itself: like the large plants, they are the result of a torrent or inundation.

But let us now examine the coal strata, and see how far their arrangement accords with our supposition.

Coal, though not extensively diffused, has nevertheless been found in every quarter of the globe, from the equator to the farthest point yet reached by human industry in the direction of the poles. It is, therefore, beyond doubt that, even in the polar regions, a state of atmospheric temperature once existed of a kind which we now call tropical; for the coal strata, wherever found, always disclose this remarkable fact—that the coal is invariably imbedded in precisely similar layers of shale, having impressions and remains of the very same plants, leaves, shells,

&c.; so that, in effect, the conditions under which coal was produced in one locality, must have prevailed in every other locality where coal is known to exist; because the botanical characters of the plants proves them to have been of a nature unsuited to any other than a tropical climate: plants such as those found in the coal shales—for example, the sugar cane—could not grow even in this country, and still less in regions to the north of Siberia, where, nevertheless, coal and coal-shale containing relics of this plant have been discovered. This singular circumstance seems to imply that, during a certain period, there prevailed all over the globe one uniform temperature, and that this period was immediately after the transition formation. To suppose that the different quarters of the world have been successively brought under the tropics, will not in any way realise the existing facts of the case; for, although this would explain the uniform nature of the plants, it would fail to account for the uniform composition of the shale, which is exactly that of disintegrated felspar, out of which the soluble alkaline silicate has been washed by water. Hence, not only must the temperature, but also the composition or structure of the earth's surface, have been uniform during the coal formation; otherwise the coal shale would not be, as we find it, identical in nature and chemical composition all over the world. But such an equably diffused temperature could not arise from the action of the sun's rays; therefore, if it ever existed, it must have been caused by the heat of the earth itself, acting through a thin crust, constituted of no more than the primary and transition formations, both of which, as we know by experiment, are much better conductors of heat than the secondary and tertiary formations. It is, however, precisely upon the upper surface of the primary and transition formations that we meet with the coal strata; and, indeed, layers of coal and shale are occasionally observed in the transition formation itself. The coal-forming period, therefore, not only closely follows upon, but actually runs into, the transition age; and it is worthy of remark, that a particular product of decomposed coal, called graphite or plumbago, is found in the very centre of the primary rocks, granite and gneiss; consequently, coal belongs to the very earliest ages of the globe, and wherever found, whether in Great Britain, Ireland, Germany, Russia, France, North or South America, New Holland, or India, presents us with the same organic remains, the same tribes and species, the same disintegrated felspar, the same sand-stone, the same iron-stone, and the same whin dikes.

If, then, we begin by admitting the hypothesis that the primary rocks have once been in a state of fusion, it is evident that a period ought afterwards to have occurred, at which the diminishing heat from these rocks, transmitted through the transition formation,

would produce an almost uniform temperature all over the world, and this, too, quite independent of the action of the sun's rays, exactly as appears to have taken place by the evidences disclosed to us in the coal formation. Again, following up our supposition with regard to the origin of coal, as lakes differ in size and depth, so we may expect to find that the different coal basins will vary in their extent and in their depth from the surface of the earth; and as we have shown that the number and thickness of the coal seams have been altogether dependent upon the accidental occurrence of floods or inundations, we may naturally look for those differences which are actually presented to us in the various coal basins; thus, at Newcastle, 28 beds have been penetrated in sinking pits, and these beds vary from the fraction of an inch to many feet in thickness, and from a depth commencing at the very surface to a profundity of more than 300 fathoms near Sunderland; the area of the lake or basin being about 800 square miles, and the number of workable or profit-paying seams about 12. In South Wales the total number of seams is about 50, of workable seams 20, and the extent of the basin about 1200 square miles: at Dutweiler, in Saarbruck, there are 32 seams, at Anzin more than 50, and at Liege 60 beds or seams of coal, of which, however, but few are workable. In fact, the results of practical observation agree exactly with our supposition, and prove that the extent and depth of the different coal basins, and the thickness of the different coal seams have arisen from purely accidental circumstances, whilst the identity of the shale in every quarter of the globe corresponds to the chemical composition of the transition and primary formations, from which alone it could have been derived.

With regard to the chemical composition of coal, there does not appear to be anything definite or fixed in the relative proportion of the elementary ingredients, so that we are compelled to class under one name a great variety of dissimilar substances. Thus, the amount of carbon in different coals varies from 65 to 95 per cent.; the hydrogen from 2 to 8 per cent.; the oxygen from 1 to 15 per cent.; and the nitrogen, which is altogether wanting in some kinds of coal, exists to the extent of 3 per cent. in another kind. But this variation is still more complicated by the fact, that a difference in composition may almost always be detected between the upper and lower parts of the same seam of coal; so that what is called an organic or elementary analysis of coal, has, in this instance, no practical value, but becomes a mere matter of curiosity. As a general rule, we find the lower beds of coal, or those resting upon the old red sandstone, to be deficient in hydrogen and oxygen, thus constituting what is called "anthracite;" and hence many geologists have come to regard anthracite as an older kind of coal than the bituminous variety. This, however, is a mistake;

for the innumerable thin layers of what has been denominated "mineral charcoal," which accompany and are embedded in the common household or Wallsend coal, are neither more nor less than true anthracite; and the production of this description of fuel is due solely to the greater mutability of the vegetable matter which produced it. That a great difference would exist in the mutability of the waxy, resinous, and fatty substances engaged in the formation of coal, is quite certain; and that this disposition to change would accompany the different kinds of coal thus produced, is more than likely. Hence we can understand how some varieties of Newcastle coal, containing only 4 per cent. of hydrogen, may rapidly evolve inflammable gas at ordinary temperatures; whilst the Boghead canal coal, which contains more than 7 per cent. of hydrogen, evolves no inflammable gas whatever. Omitting for the moment all notice of the ash, which invariably accompanies every description of coal, we now give a tabulated statement of the elementary ingredients, such as we have found them in carefully selected samples of the three following varieties of coal:—

	Carbon.	Hydrogen.	Oxygen, Nitrogen, and Sulphur.
100 parts of anthracite consisted of...	90·20	2·75	7·05
Newcastle bituminous coal	85·00	5·20	9·80
Scotch canal coal	80·10	7·40	12·50

The quantity of ash in coal can scarcely be said to have any definite limits, until we reach that point which brings it within the range of bituminous shale; and in this respect it may be doubted whether any mineral fuel containing more than 25 per cent. of its weight of ash ought to be regarded as coal. But the amount and nature of this ash is sometimes of very great importance. For example, it is extremely inconvenient that a household coal should produce more than 3 per cent. of ash, and it is still more inconvenient if this ash should happen to be of a light flocculent nature. A desirable kind of ash for household coals should have a reddish-yellow color, due to the presence of oxide of iron, which, by increasing the specific gravity of the ash, prevents it from flying about and damaging the furniture in the house; whereas a light, white ash, consisting as it does chiefly of minutely-divided silica, is highly objectionable and injurious. The quantity of sulphur present in coal is very variable; and although this sulphur commonly exists in the form of bisulphate of iron or pyrites, yet such is not always the case, for we have examined many specimens of coal in which a large proportion of the sulphur was united to the organic matter, and had no metallic or earthy basis to retain it. This, in regard to gas-coals, is an important distinction; for in the instances alluded to, nearly the whole of the sulphur would pass off into the gas,

The largest amount of sulphur which we have observed in any fair sample of coal has never exceeded 3½ per cent.; and when the visible pyrites have been removed by the usual process of hand-picking, the sulphur has rarely exceeded 2 per cent. In common Newcastle household coals it is only about 1 per cent., and this is altogether due to pyrites. The condition of the pyrites in coal is, however, occasionally a most serious question, for when this substance is disseminated in thin filaments or laminæ throughout the body of the coal, it totally unfits it for long voyages at sea, because such a kind of coal, on being wetted, is almost certain to heat and burst spontaneously into flame. Far too little public attention has hitherto been bestowed upon this peculiarity, though the mischief which it causes is by no means of unfrequent occurrence. In fact, no distinction seems ever to have been drawn between the minutely-disseminated and the more compact varieties of iron pyrites. But the difference in chemical effect between these two is as great as possible—as great, indeed, as the difference between a mass of spongy platinum and a solid bar of that metal. It is not that the coal contains iron pyrites, but that it contains this substance in a minutely-divided form, which, therefore, exposes a larger surface to the oxidating power of the air, and thus causes spontaneous ignition. Many of the coals of Belgium, France, and South Wales are liable to this dangerous objection; and it would be well if some member of the House of Commons would propose that a record shall, for the future, be kept of the name of the coal on board every ship or steam-vessel which happens to take fire at sea from unknown causes.

[We observe in our esteemed contemporary, the *Mining Journal*, that a correspondent has taken upon himself to quarrel with our expression, "canal coal." He cites an authority, dated 1686, for the derivation of the word cannel, from the ancient British "canwyll," which he tells us means a candle. But the ancient Britons knew nothing of candles, therefore if they really used the word "canwyll," it must have meant something else than a candle. From a chronological table printed in the year 1828, and prepared by Dr. G. H. Robinson, LL.D., we find that in the year "685 the Britons were altogether expelled by the Saxons, and driven into Wales;" but it was not until more than 600 years after this that candles came into use in England; for in the year "1298 silver-hafted knives, spoons, and cups were reckoned great luxuries, as well as tallow candles, splinters of wood having been hitherto used for lights." Canals were, however, in use in England long before the year 1686, though they were then made always in the beds of rivers; thus (not to mention Sir Hugh Middleton's canal, the New River, which was begun in 1606, and finished in 1614), in the year 1635, a Mr. Sandys, of Flatbury, in Worcester, proposed a canal to render the Avon navigable through the counties of Warwick, Worcester, and Gloucester, "that the towns and country might be better supplied with wood, iron, pit coal, &c." It need not, then, surprise us if, in a district like Staffordshire, the word canal has been corrupted, as it clearly has been in Lancashire. But our view of the case appears to be also that of our legislators, for in the year 1792, when a tax of 5s. per chaldron existed upon "sea coal," a duty of 1s. per chaldron was imposed upon all canal coal brought to London.]

(*To be continued.*)

Recent Patents.

To EDWARD JOSEPH HUGHES, *of Manchester, for improvements in dyeing and printing,—being a communication.*—[Dated 7th June, 1864.]

THIS invention consists in the production of a black color on cotton or linen cloth or yarns, by the admixture of a salt of aniline with chlorate of potash and sulphuret, or sulphide of copper, or sulphuret or sulphide of iron, or mixtures of the same,—the proportions to be about sixteen ounces salt of aniline, four ounces sulphide of copper, and four ounces chromate of potash to one gallon of water. The use of sulphide of copper or iron with the salt of aniline and chlorate of potash in about the proportions already described, when the black is required to be printed, are said to remove the difficulties hitherto experienced in using a salt of aniline with soluble salts of copper. When dyeing black by this process, the sulphide of copper or iron is first precipitated in the cloth or yarn, and the cloth or yarn is subsequently passed through a solution of a salt of aniline and chlorate of potash. The cloth or yarn is afterwards aged and washed, when the black color is produced.

To NAPOLEON SARONY, *of Birmingham, for improvements in the production and treatment of photographic portraits or pictures.*—[Dated 9th June, 1864.]

THIS invention consists in imparting to photographs the appearance of drawings or engravings, by printing upon the photograph a background or fore-ground, in sketchy touches, lines, or tints, such as artists finish their crayon or other drawings with, or as engravers produce their tints.

In producing this effect by means of photographic printing, the patentee first obtains the negative picture of the sitter or other subject in vignette, in the ordinary well-known manner; and he then takes a second negative upon glass. This second negative consists merely of the hatching or sketchy lines photographed upon the glass from a chalk, pencil, or other drawing of such lines. He next takes the picture in vignette, and afterwards, by means of the second or etching negative, photographs the lines upon the picture; the light being prevented from acting upon the face of the portrait, or upon any desired part of the picture, and developing the lines only, by blocking out such parts as should not have the lines at the back of the vignetting glass. By another process, the effect of etched vignettes is obtained by etching the lines by acid, upon the usual vignetting glass, employing, if necessary, thin varnish or other suitable medium as a coating for the etching lines, and to produce half tints, if the crude lines should print too darkly; or the vignetting glass may be coated with japan varnish, and the varnish etched through, the half tint being produced by coating the lines with thin varnish. To produce the same effect by other modes of printing—such as lithography, copper-plate, or wood engraving—the lines from the stone, plate, or block, are printed upon the paper upon

which the photographic picture is to be taken, or after it has been taken.

The patentee claims, "the improvements in the production and treatment of photographic portraits or pictures, in imparting to them the appearance of drawings or engravings, by the means set forth."

To William Martin, *of Dundee, for an improved method of working mangles employed in finishing cloth, and in beaming the rollers of same.*—[Dated 13th June, 1864.]

The first part of this invention consists in moving laterally the large stone or other heavy body or chest of the mangle, for finishing linen, cotton, and similar fabrics, by the direct action of steam or other gas or fluid pressure, so that the speed and length of travel of the mangle may be instantly modified and varied at pleasure, and without stoppage.

The patentee fixes near one end of the chest of the mangle, in the line of its motion, and at about the level of its centre of gravity, a steam cylinder, connected by a steam pipe with a boiler. The cylinder should be of sufficient length to allow its piston as much travel as the maximum travel of the chest; the piston is directly attached to the near end of the chest by an open eye, constructed to admit of a little elevation and depression of the chest-level, without bending the rod; or a connecting rod—jointed to the end of the piston rod proper, and attached to the mangle chest by a joint—may be used. The steam valves of the cylinder are so adjusted, as to be free to open fully at once and shut off the steam gradually, so that the chest may not be stopped too suddenly. To prevent this, provision may be made for a steam pillow at each end of the cylinder; but the friction of the cloth rollers is so great, that this will not be necessary with ordinary care and usual speed.

When the cloth to be mangled requires to be first calendered, the patentee combines this operation with that of beaming the cloth at once upon the rollers which go under the chest of the mangle. This may be done, first, by using the mangle rollers as stripping rollers for the calendering operation, driving them by a slipping friction belt going at a greater speed than the calender rollers; or, second, by inserting the mangle roller upon or between the calender rollers, in the frame or gables of the calender; giving pressure by any of the usual methods, and shifting the mangle rollers from the calender when full. The cloth may also be rubbed, if necessary, in passing through the calender rolls in any convenient manner. By this arrangement, all these operations may be combined in one, so saving expense.

The patentee claims, "First,—working mangles, by the direct action of steam, or other gas or fluid pressure, as described. Second,—beaming the mangle rollers, by attaching them to the cloth on the calender rollers by pressure or friction in the preliminary operation of calendering, as described."

To Morgan Morgans, *of Brendon Hills, Somersetshire, for improvements in blast furnaces.*—[Dated 10th May, 1864.]

This invention consists in constructing blast furnaces with a central core, by preference conical, and extending upwards to any desired height in the furnace. Tuyeres, pointing inwards to the furnace, are inserted in the hollow, and a blast is thus introduced, when required, through the core, in addition to the ordinary blast. In some cases the whole blast may be driven through the central core. Or the core may be made solid, and then the blast may be introduced in the ordinary manner.

In Plate IX., fig. 1 is a vertical section, and fig. 2 is a plan, on the line A, B, of fig. 1, of one of the blast furnaces. C, is a central core extending to the top of the furnace; D, is a chamber inside the core, which may be entered at the bottom under the furnace, while the waste gases may be carried off from the upper part. The dotted lines *a*, *a*, represent the centre lines of blast or tuyere irons, through which blast may be forced from the inside of the central core; and the lines *b*, *b*, represent the central lines of tuyere irons for the blast from the outside of the furnace. *c*, *c*, are tapping holes.

Fig. 3 is a vertical section of another form of furnace; C, is the central core; D, is the chamber which is entered at the sides; and the annular hearth is shown divided in two places, but the hearth may be made to pass under the entrance arches.

Fig. 4 is a vertical section of another of the furnaces. Here the chamber inside the core is dispensed with, as also the blast from the interior. The core C, may be either hollow or solid.

Fig. 5 is a vertical section of a blast furnace. The dotted lines show the manner in which an ordinary blast furnace, as already constructed, may be converted into one according to this invention; the central core C, may be either hollow or solid, and the walls between the core C, and the outer dotted lines *d*, *d*, must be removed

The patentee claims, "constructing blast furnaces with the central core substantially in manner described and represented."

To William Reid, *of Adelaide-road, Haverstock Hill, for improvements in apparatus used for testing the insulation of electric telegraph wires or conductors.*—[Dated 16th May, 1864.]

The object of this invention is to arrange apparatus suitable for testing joints and small lengths of insulated or coated wire or other form of conductors. For this purpose a strong box or vessel is constructed, having at its opposite ends suitable packings or stuffing boxes. In testing the state of insulation of a joint, it is placed in the box, which is secured tightly. The portion of the coated electric wire within the box or vessel is subjected to exhaustion and pressure; the packing at the ends of the box, where the wire enters and leaves such box or vessel, rendering such parts fluid and air-tight.

In Plate IX., fig. 1 shows a plan, and fig. 2 a transverse section, of the apparatus employed when carrying out this invention. In this arrangement the lower part of the apparatus is shown to be fixed to a

platform or upper surface of a table, but when desired the apparatus may be mounted on wheels, to facilitate the apparatus being moved from place to place. The apparatus should be made of a strength suitable for testing joints or other short sections or lengths of a telegraph cable, or a pressure as large as, or larger than, that offered by the depth of water in which the telegraph cable is to be immersed, and the testing should be at a pressure rather in excess than below the pressure of water in which the cable is to be sunk. The apparatus consists of an oblong vessel, by preference in two parts, capable of being clamped or held together so as to resist the requisite internal pressure.

a, *b*, are the two halves of the vessel, and *c*, *c*, are the two parts of the elastic packing. A joint or short section of the cable *d*, being put into position, the two parts of the vessel are to be held securely together by cross heads, bolts, and keys, or otherwise. The air being exhausted from the interior of the vessel, the vessel is to be filled with water, and, by means of a force pump, the portion or short length of the cable is to be put under the desired extent of pressure; a delicate galvanometer is to be placed in circuit with the two ends of the cable, and any imperfection in the insulation will readily be detected. It is preferred that the apparatus should be suitable for testing about 8 to 12 feet of the cable.

The patentee claims, the mode herein described of combining apparatus for testing the joints and short lengths or sections of electric telegraph cables.

To WILLIAM TASKER, *the younger, of the Waterloo Iron Works, near Andover, for improvements in combined thrashing machines.*—[Dated 20th May, 1864.]

THIS invention relates to the elevating and delivering of the chaff into bags or other suitable contrivances placed to receive it after it has been separated from the corn in the ordinary manner, and consists in the application and use of an adjustable blast or blasts, or a combination of blasts of air produced by and received from the same fan that creates the blast for the separation of the chaff from the corn in the usual way, and in the disposal of such blast or blasts, or combination of blasts, of air in the manner hereinafter described for the elevating or delivering of the chaff into bags or receptacles as required, without the aid of the fingers, cup elevators, or projections attached to revolving endless bands, as hitherto employed. It is also proposed to use an exhaust for the like purpose.

In Plate IX., fig. 1 represents a longitudinal vertical section of a portion of a combined thrashing machine to which the improvements are applied.

Fig. 2 is a corresponding transverse vertical section of the same, taken along the line 1, 2, in fig. 1.

A, is the ordinary fan blower for separating the chaff from the corn, which it does by means of a blast delivered at the mouth B, into the heaver or riddles C, of the winnowing apparatus. In addition to the mouth B, there is provided a supplementary but smaller mouth D, communicating with the fan blower, and furnished with an adjustable valve

E, for controlling the second blast. The mouth D, of the secondary blast is situate immediately opposite to the open mouth of a case F, which is continued under the heaver, and receives the secondary blast. The first or main blast from the mouth B, after having separated the chaff from the corn, passes onwards in the direction of the arrow towards the front end of the heaver, carrying the chaff along with it into a transverse shoot G, which forms a part of the heaver, and which is inclined towards the side of the machine, where it opens into a receiver H. A portion of this blast escapes through the perforated or wire-gauze end I, of the heaver, whilst the remainder enters the receiver H, through the opening made for that purpose in the side of the heaver, and carries the chaff along with it. The case F, is continued underneath the transverse shoot G, and opens at K, into the bottom of the receiver H, immediately underneath the delivery end of the shoot G. As the chaff enters the receiver H, it descends towards the bottom of the receiver, the primary blast being weakened by the escape of a considerable portion of it through the wire-gauze I; but the chaff, in the act of falling, is caught up by the full force of the secondary blast, which enters the bottom of the receiver at K, and, by the combined action of these two blasts of air, the chaff is blown up the vertical spout L, fixed over the receiver H, at the side of the machine, and into the perforated head M, fitted on to the top of the vertical spout L, whereby the air is allowed to escape, as shown by the arrows, whilst the chaff descends into a sack, the mouth of which may be hooked on to the perforated head M.

The two openings D^1, B^1, at the upper part of the fan casing, serve to conduct a portion of the wind to another part of the machine, for the corn to pass through after it has passed through the first winnowing, in place of using separate fans,—one fan being made to serve for all.

According to a modification, of which fig. 3 is a transverse section, an exhaust fan N, of any suitable construction, is employed, keyed on to a spindle O, revolving with it in suitable bearings, and receiving motion by the pulley P. This fan is situate on the top or at the end of the vertical spout L, whereby the chaff is drawn up from the receiver H, being assisted in its ascent by that portion of the blast from the fan A, fig. 1, which enters the receiver, and after passing the fan N, continues its course through the spout Q, and case R, into a sack S, placed to receive it.

Fig. 4 represents a section, taken transversely through the machine, of a slightly modified arrangement for elevating and delivering chaff by means of an exhaust fan. In this arrangement the spout G, is divided at the point T, so that a portion of the chaff is conducted to each side of the machine into the receivers H, H, communicating with the vertical spouts L, L. On the spindle O, a fan N, is keyed, working in suitable bearings, and receiving motion from the pulley P. This fan is a double one by preference, but may be single if desired. By the revolution of the exhaust fan N, the chaff is drawn up from the receivers H, H, through the vertical spouts L, L, and is delivered through openings U, U, at the circumference of the fan, into hoppers V, V, and through the inclined spouts W, W, into sacks placed to receive it at the end of the machine.

The patentee claims, "First,—the general construction and arrangement of combined thrashing machines, substantially in the manner and for the purpose described. Second,—the application and use, to and in

the elevating and delivering of the chaff in combined thrashing machines, of an adjustable blast or blasts, or a combination of blasts of air produced by and received from the same fan or blower which creates the blast for the winnowing of the corn, substantially as described. Third,—the peculiar mode of disposing and applying blasts of air in combined thrashing machines, substantially in the manner and for the purposes described. Fourth,—the application and use to and in the elevating and delivering of the chaff in combined thrashing machines of an exhaust fan or fans, disposed as described. Fifth,—the application and use of an exhaust fan in conjunction with one or more blasts of air obtained from the winnowing fan in combined thrashing machines, for the purpose of drawing up and delivering the chaff, as described. Sixth,—the combination of independent blasts of air of the same or different velocities, for the purpose of elevating and delivering the chaff in combined thrashing machines."

To THOMAS AVELING, *of Rochester, and* THOMAS LAKE, *of Tong, Kent, for improved apparatus to be used in steam cultivation.*—[Dated 6th June, 1864.]

THE object of this invention is to economise the manual labour required in carrying on the operation of steam ploughing. Hitherto, the practice in steam ploughing has been to plant stationary pulleys or rope porters in the line of draft, to prevent the draft-ropes from trailing on the ground, and at every shift of the tilling implement, the attendants have had to shift these rope porters, and reset them to suit the new line of draft.

In place of this system of operation, it is proposed to effect a temporary attachment of the ropes to the rope porters, and to enable the rope porters to travel with and hold the ropes suspended until they severally reach the headland or fixed tension pulley, when they may be instantly disengaged from the ropes, and offer no obstruction to the progress of the tilling operation.

In order to render a travelling rope porter efficient, it has been found necessary that it shall be enabled to pick up, or assist in picking up, the rope, as it lies extended on the ground, and not require the rope to be hoisted up and placed upon the carriage. To this end, the patentees construct their rope porter, as shown in Plate X., where fig. 1 represents it in side elevation, and fig. 2 in plan view. A, A, is a beam, carried by a pair of running wheels B, the axle of which is cranked, and forms the fulcrum on which the beam is free to rock. At its rear end, this beam terminates in a handle; it forms, therefore, a hand lever, and is capable of being rocked, to depress or raise its forward end, for the purpose to be presently explained. At its forward end, this lever carries a hook or eye *a*, for lifting the rope from the ground. When the rope is caught in this hook, it will be held up in contact with a V friction piece *b*, affixed to the under side of the beam, near the forward end thereof, which friction serves to bite the rope, and effect a secure temporary coupling of the rope and rope porter. Near the hinder end of the beam or hand lever, is a guide, through which the rope is led, in order that the rope may have no ten-

dency, by a jerk or otherwise, to free itself from the grip of the V piece *b*. This guide is shown detached, and on an enlarged scale, at fig. 3. It consists simply of a double flanged collar *c*, surrounded by a loose clip *d*, which is weighted, to make it take and retain a vertical position. The collar is made with a transverse V-shaped indentation, which is prolonged by horns for guiding the rope into the recess, and the clip is similarly provided with horns. The collar is keyed to the beam A, with the V-shaped indentation downwards. In order to introduce the rope into the guide, the clip is turned to bring its opening into coincidence with the groove or indentation of the collar; and when the rope is raised into the groove, the clip is let go, when it will swing round and secure the rope in the groove. From this explanation, it will be understood that the rope porter will admit of being instantly detached from, and re-attached to, the rope as often as the shifting of the tilling implement is required to be effected. In order to prevent the travelling porter which follows the tilling implement, and assists in supporting the back rope free of the ground from following, as its tendency is, in the line of the back rope, and thus running on the cultivated land, the porter is provided with locking gear, which will cause it to run at an angle to the back rope. This locking gear consists of a rigid rod *e*, which is jointed to the beam A, near the head thereof, and at its rear end it is fitted with pin holes, into which a pin is dropped, in order to connect it with the axle of the running wheels. This rod is intended so to fix the axle of the running wheels relatively to the bar, that the travelling porter will run obliquely to the line of that bar; for this purpose, it is necessary to couple the bar to the axle by the intervention of a turn-plate or locking-plate, which will admit of the bar turning slightly, so that it may be held fast in an oblique position by means of the rod *e*. The end of the rod *e*, is furnished with a handle for shifting its position.

The patentees claim, "the means above described for suspending the ropes employed in steam cultivation clear of the ground."

To JOHN FOWLER, junior, *of Leeds, for improvements in horse shoes.*—[Dated 21st May, 1864.]

IN order to obviate the injury to horses arising from the jar to the hoof and legs in travelling on hard roads, it is common to put leather between the hoof and the shoe, and vulcanized india-rubber has been tried with the same object. By means of leather the object is but very imperfectly attained, as leather so placed is but very slightly compressible. By substituting vulcanized india-rubber for leather, much greater elasticity is obtained; but it is found that the shoe, in working up and down on the nails, in a short time makes them loose, and the shoe is thrown off.

This invention consists in placing the vulcanized india-rubber between two metal shoes; the inner one is nailed to the hoof as heretofore, and it has studs upon it, which pass through the vulcanized india-rubber, and so keep it in its place; and below the india-rubber the studs carry the outer shoe, so as to retain it securely in its place, but the shoe is able to work up and down freely on the studs. The studs

may be projections from or parts of the nails, but it is preferable to make them separate.

In Plate IX., fig. 1 shows a plan; fig. 2 a section on line A, B, showing the nail hole; and fig. 3 a section on line C, D, showing the stud hole. *e*, is the outer shoe, which is made to work up and down freely on the studs *h*, *h*; *f*, is the inner shoe, which is fastened to the horse's hoof in the usual manner; *i*, *i*, are the nail holes; *h*, *h*, are the stud holes.

To George Moulton, *of Manchester, for improvements in turntables applicable to overhead railways.*—[Dated 25th May, 1864.]

This invention consists in the arrangement and adaptation of turntables to overhead railways employed in transporting heavy goods from one place to the other in warehouses and other places. The various lines of railway are connected by hangers to the beams of the ceiling or other overhead place, but hitherto these railways have been only in parallel lines, in consequence of the non-existence of suitable turntables, and the object of this invention is to remedy that defect, and enable lines to be placed at any angle with the main parallel lines, and thereby supply a desideratum which has long been required.

In Plate X., fig. 1 is an elevation of the improved overhead turntable and carriage in connection with rails for the purpose of transmitting or travelling bales, boxes, packages, barrels, and other goods to any required part of the room, or placing them one upon another to very near the ceiling; fig. 2 is a plan of the under side, showing the openings for the rails and travelling carriage; and fig. 3 is a vertical section of the same; fig. 4 is an elevation of the rails, hangers, and beams; and fig. 5, a plan looking from above, with the flooring removed.

The outer stationary casing of the apparatus is shown at *a*; it is provided with an external flange *b*, for enabling it to be suspended and bolted to an overhead beam or support. In the interior of the casing there is an internal flange *c*, on which there is any required number of pulleys, rollers, or spheres *d*, for carrying, by means of the flange *e*, the turntable *f*, through which there is an opening or passage *g*; and in the lower part of the casing there are four openings *h*, for allowing the entrance and exit of the carriage which travels on the rails *k*, the ends of which rails rest on projections *l*, and are screwed or bolted to the sides of the openings *h*; it being understood that the bottom of the passage in the turntable is in line with the tops of the rails. At the top of the turntable there are projections or stops *m*, fig. 3, and in the middle a boss *n*, in which there is a pin *o*, the top of which is in contact with the latch *p*, which at one end is held loosely to the outer casing, and at the other end is capable of moving up and down in a slot in the casing; and in the middle of the latch, in line with the pin, there is an adjusting screw *q*, to which access is obtained through an aperture or armhole *r*. The travelling carriage consists of a thick plate *s*, carrying the pin *t*, for forming the bearing for the two wheels *u*, the sides of which correspond with the rails *k*, and their peripheries travel upon them. The lower part of the plate *s*, passes through an opening *v*, at the bottom of the turntable, and through the space v^1, between the rails, which part

of the plate is made wide, to act as a guide and keep the pulleys in line with the rails. At the bottom of the plate there is a bearing *w*, to which the lifting blocks are attached, and at the upper part of the plate there is a small roller or pulley *x*, for raising the latch and releasing the turntable, when the pulley strikes the bottom of the pin *o*, as the carriage is going on the table. The spheres *d*, are for lessening the friction of the turntable, but they may be dispensed with, and a swivel joint used instead. The rails are connected to hangers *y*, figs. 4 and 5, constructed so as to leave ample space for the carriage to pass along, the hangers being fastened to longitudinal and cross beams *z*, or to any other suitable supports. The goods are received at the door b^1, fig. 4, above which, at or about the centre, a line of rails is placed with the turntables as at a^1, fig. 5. The goods are hoisted up by means of differential or other pulley blocks connected to the bearing of the travelling carriage, and are then run along the line and through the turntables without stopping, until they arrive at the one connected to the line in which the goods are required to be placed. When the carriage enters the outer casing, and arrives at the centre of the turntable, it raises the latch, so that the table can be turned one quarter round, and the openings are placed in the right direction for the exit of the carriage; and, before the final exit, the latch falls and holds the turntable right for the return of the carriage. The goods are then moved along the rails, and lowered into the place required, after which the carriage is returned for a fresh load.

The patentee claims, "the construction and application of overhead turntables, as herein described, or any mere modification of the same."

To COWPER PHIPPS COLES, *of Southsea, Hants, for improvements in protecting the bottoms and sides of wooden and iron ships and other submerged structures.*—[Dated 21st May, 1864.]

THIS invention consists in means of affixing to the bottoms and such portions of the sides as are liable to be submerged, of iron and wooden ships, caissons, and like structures, cements, stuccos, and concretes, or other like substances. In wooden ships and structures, nails, brads, tacks, eyes, spikes, or other like holding agents, are first driven into such portions of the structure as are to be protected, at about one inch apart, more or less, and having about half an inch protruding. The holding agents can be driven in at an incline, or they may be more or less bent after having been driven in. The cement, or other substance or composition, is applied after the holding agents have been inserted. With iron ships and structures, a light sheathing of wood is first applied to receive the nails or other holding agents, and then the cement, or other like protecting substance or composition. Or studs are sometimes caused to be rolled or formed on the plating for iron ships and other iron structures, and these studs are used as the agents for holding the protecting substance or composition. Or a thin metal plate is fixed, by means of screws tapped into the ship's sides or bottom proper; this plate, before being put on, has flaps cut in it about half an inch square, and about one inch, or one inch and a half apart. After the plate is on, these flaps are turned up at an angle of

about 45°; and the flaps or portions of the plate so turned up take the place of studs or nails for holding on the cement or other protecting substances.

To George Herbert, *of Summerhill, near Dartford, and* Robert Stainbank, *of Verulam-buildings, Gray's-inn, for improvements in apparatus for sounding a bell applied to a buoy or other floating body.*—[Dated 30th May, 1864.]

It has been proposed to sound a bell, applied to a buoy by means of a ball rolling in a trough or guide, mounted on the buoy or floating body. The ball, in moving to the part of the trough which for the time happened to be lowest, came in contact with levers or instruments which caused the bell to sound. As each roll of the sea produced a fresh movement of the ball, the bell was continually sounded; this arrangement has, however, been found more or less complicated and inconvenient.

According to this invention, the ball or other heavy body, in place of moving in a trough or guide, is controlled by being mounted on an arm capable of turning on a centre.

The figure in Plate X. shows a side view, partly in section, of an apparatus constructed according to this invention. In this figure, a portion only of the framing by which the apparatus is supported upon the buoy or other floating body is shown. *a*, is a ball or weight, the movements of which are controlled by its being mounted on the arm *b*, that is capable of turning around the upright axis *c*; a wheel *d*, is also carried by the axis *c*, and the wheel is connected with the arm *b*, so that it shall turn with it. On the surface of the wheel *d*, is an excentric track. Into the excentric track on this wheel are received the lower ends of the cranked levers *e*, *e*, which give motion to the hammers; these levers turn on centres at e^1, e^1, and at the upper end of each lever is hinged a finger *f*, which acts on the lower arm of a lever *g*; the upper arm of which is furnished with a hammer for striking the bell *k*. The excentric groove on the wheel *d*, is arranged to lift each of the hammers three times for every complete revolution of the wheel around the axis; but the groove may be differently formed to cause the hammer to be raised a greater or less number of times for each revolution of the wheel. When the wheel, by the rolling of the buoy or vessel, upon which the apparatus is mounted, is caused to turn or oscillate around its axis, the form of the groove upon it causes the lower ends of the levers *e*, to be moved to or from the axis *c*; this raises or lowers the upper ends of these levers. As the upper end of either of the levers is raised, the finger at its end acts on one of the levers *g*, and raises the hammers carried by it away from the bell, until, by the continued movement of the lever, the finger has moved away from under the end of the lever *g*; the hammer then falls, and strikes the bell. The hammers are prevented from resting against the bell, after they have delivered their blow, by springs *i*, *i*, as is shown. On the continued rotation or oscillation of the wheel, the upper end of the lever will be moved downwards, until the finger carried by it comes below the end of the lever *g*; the finger, by turning on its pin-joint, allowing of its so passing below the lever. The lever is then ready again to raise the hammer.

To George Coles, *of Gresham-street West, and* James Archibald Jaques *and* John Americus Fanshawe, *both of Tottenham, for improved machinery or apparatus for producing thin strips or filaments from various substances.*—[Dated 4th June, 1864.]

This invention relates to a novel arrangement of machinery, whereby natural or artificial skins of leather, or sheets or skins made from gelatinous or gummy substances or compositions, may be divided into thin strips, shreds, or filaments.

In Plate X., fig. 1 represents, in longitudinal section, the improved machine. *a*, is the supporting roller over which the sheet *b*, to be cut into strips, passes. It is mounted in bearings at the ends of a pair of levers *c*, which are mounted on centres c^1, in short standards fixed on the stationary framing of the machine, so that they may be vibrated thereon, in order to raise or lower the supporting roller *a*, as may be required. The levers *c*, are connected by means of links c^2, to other levers c^3, on the axle of the hand lever *d*, which rocks on the centre d^1, as its fulcrum. The supporting roller *a*, may therefore be raised or lowered by the workmen while the machine is in motion, so that by lowering the roller *a*, the sheet—say of caoutchouc—will be withdrawn from the action of the cutters, or, by raising the roller, will be brought in contact with the cutters. Above the supporting roller *a*, is mounted a shaft e^*, which carries a series of circular cutting discs *e*, set close enough together to cut the sheet into threads or filaments of the requisite fineness. This shaft e^* has a rapid rotary motion communicated to it by suitable gearing, while the sheet of caoutchouc is drawn forward by the nipping rollers *f*, over the supporting roller *a*, on which it is stretched by the drawing action of the rollers *f*, *f*. To facilitate the cutting operation, the rotary cutters *e*, are kept wet by water dripping from a pipe e^3, on to them, as is usual in this class of machinery. It will be seen that there are two pairs of nipping rollers: one pair *f*, *f*, is placed in front of, and the other pair *g*, *g*, behind, the supporting roller *a*, and both pairs nip or hold the thin sheet of caoutchouc or other substance firmly, and keep it in an extended state while passing over the supporting roller *a*,—the rollers *f*, *f*, receiving a quicker motion than the rollers *g*, *g*. The sheet of caoutchouc to be operated upon is wound on a beam *h*, and secured thereon by its inner end. The beam *h*, is provided with suitable gear for letting off the sheet at the proper speed, and, if desired, the elastic sheet of caoutchouc may be wound on the beam *h*, in a stretched or extended state, and led from thence to the rollers *g*, *g*, and *f*, *f*, which will then only act as holding or nipping rollers, in which event they must of course both be driven at the same speed, or nearly so. In operating with this machine, the outer end or beginning of the sheet is passed between the nipping and stretching rollers, and between the supporting roller and cutting discs, and is then secured to the draught roller, on which the threads, when cut, are to be wound. The sheet will thus be pulled forward under the cutters *e*, by the nipping rollers *f*, *f*, and the draught roller.

Instead of the bearings of the supporting roller *a*, being made moveable up and down, and the bearings of the cutter shaft e^*, stationary, as in the arrangement just described, the supporting roller may be mounted in fixed bearings, and the cutter shaft in moveable bearings in the end

of vibrating levers, so that the cutter shaft may be raised or lowered as may be required to bring the cutters into contact with the sheet to be operated upon while the supporting roller remains stationary.

Fig. 2 represents a front elevation, and fig. 3 a vertical section, of a modification, in which the supporting roller *a*, is mounted in stationary bearings. The bearings of the cutter shaft *e**, are moveable in a vertical direction: this is obtained by means of the vertical screws *i*, which pass through female screws in the ends of the transverse piece *j*, of the framing. Each of the screws *i*, *i*, carries at its upper end a toothed wheel i^1, into which gears a central spur wheel *k*, on the axle of which is a winch handle k^1, whereby it may be turned in either direction, so as to raise or lower the bearings of the cutter shaft, and consequently the cutting discs *e*, mounted thereon. The screws *i*, *i*, should be cut with a moderately quick thread, so that one or at most two turns of the winch will be sufficient to withdraw the cutting discs from the sheet of caoutchouc.

It will be evident that the machines above described for dividing or cutting up sheets or skins into thin filaments or threads may be employed to cut up various kinds of tissues—such as natural or artificial skins or leather—into narrow strips or bands; the width of the strips or bands being determined by the distance at which the cutting discs are placed from each other on their shaft or axle.

The patentees claim, "the mode herein set forth of producing threads or filaments from sheets of caoutchouc or compounds of caoutchouc or other fabrics or tissues while in a stretched or extended state; particularly the mode herein set forth of mounting the axle of the cutting discs and the axle of the supporting roller, so that either the cutting discs may be capable of being lifted by the workman away from the sheet, or brought into contact therewith; or the sheet with the supporting roller may be lowered away from and out of contact with the cutting discs, or brought up against them, as may be required, in order that the cutting operation may be either arrested or commenced, or continued at any time without stopping the machine."

To Jacob Snider, junior, *of Chancery-lane, for improvements in ordnance.*—[Dated 4th June, 1864.]

The first part of this invention relates to the use of cylinders in the transforming of smooth-bore muzzle-loading cannon (which previously fired spherical shot) into cannon, to fire elongated projectiles, where the inserting of a cylinder into the gun is used to contract or reduce the bore; also to cannon of any sort to be constructed and used as muzzle-loaders where a cylinder is used for the interior of the gun.

When operating on cast-iron or bronze cannon of the usual government pattern, a hole is bored through the rear axis of the gun into the chamber or bore formed by the inserted cylinder. This cylinder has its breech end closed, and its external end surface fits mechanically into the chamber seat in the gun. Fitted into the chamber seat is a cup-shaped valve, made of steel or other metal, constructed with a shaft or solid shank at its rear. The bearing of the convex face of this valve, under explosion of the powder charge, is relieved by reducing a portion

of its convex face within its outer annular edge, so as to secure elasticity or flexion, and also to cause it to act as a gas check, to prevent escape of gas. On the end of the valve shaft is cut a screw thread, on to which a stout metal nut is screwed, which replaces the cascable. By screwing tightly up this nut on the valve shaft against the external breech of the gun, the cylinder is brought firmly to its place. By the employment of this valve, the recoil bears against the valve, so that, instead of there being a tendency, on the discharge of the gun, for the cylinder to move forward, it will be retained securely in place. When it may be desired to inspect the bore of the gun, or when, by much use, the bore may have become injured, then, by unscrewing the nut from the valve shaft, the valve can be driven out and the bore readily inspected, or even the cylinder may be extracted, to be replaced by another if required, and thus the original gun or shell will be preserved.

The figure in Plate X. is a longitudinal section of so much of a piece of ordnance, transformed in the manner before described, as will be necessary to illustrate the invention. *a*, is the original arm, which is bored truly to receive the cylinder *b*. This cylinder is inserted by the muzzle of the gun, and adjusted nicely to the bore thereof. *c*, is the cup-shaped valve made with a shaft *d*, one end of which is screw-threaded. The shaft *d*, of the valve is inserted through an aperture formed through the end of the cylinder *b*, and the breech end of the arm, as shown, and there secured firmly by the nut *e*. On removing the nut, the valve can be taken out.

The second part of the invention consists in making a close joint between the valve face and chamber seat, and valve shaft and holes in the cylinder and gun, and also on any other part or parts of junction, or on the inner or concealed surfaces of cannon or guns of any description, so as to make the same air, gas, or water-tight, and also to prevent oxidation by covering all such surfaces or junctions with a "graphitic composition" or "paint," made as described in the specification of a patent, dated December 2nd, 1861, No. 3024, granted to Gerard Ralston, of which packing or paint "graphite" forms the principal component part, or in whatever way it may be made, provided graphite forms the base.

The third part of the invention is as follows:—In order to relieve the percussive or sudden strain arising from the impulsive action of the explosion of the powder-charge, from bearing too violently on the outer shell or original gun, and to enable the steel cylinder to flex or dilate under the explosive action of the powder-charge, a certain portion of the outer surface of the cylinder or the inner surface of the gun is taken off; commencing from a certain distance forward of its rear or chamber end, up or forward to near the trunnions, or for such distance as the size and bore of the gun will admit of or require for the end or purpose to be attained (as size and bore or other considerations will respectively determine), or within the compass of that distance of a portion of the gun where the greatest percussive force of the explosion of the powder-charge exerts itself; thus placing a portion of the outer surface of the cylinder in non-contact with the inner surface of the outer shell or gun.

f, shows a portion of the outer surface of the cylinder removed, and *g*, shows a portion of the inner surface of the cannon removed.

The application of the principle of causing a portion of the outer surface of a cylinder to be free of contact with a certain portion of the interior of the gun, in manner hereinbefore described, may be adapted to any cylinder or cylinders introduced into a gun or guns of any description, be they muzzle-loaders or breech-loaders, old guns transformed or converted, or to new guns, or guns made especially to receive cylinders. This mode of making and applying the principle of non-contact and elasticity or flexion under explosive action to cylinders in cannon, may be applied also to the making of new cannon, be they composed of one or more consecutive cylinders, the one placed within the other, and one or more of them respectively having its or their external surface at or on any portions thereof slightly reduced, so as not to be in contact with the inner surface of the shell, casing, or cylinder covering it, or which would otherwise be in contact with the inner cylinder at the portions and in manner referred to. This method of non-contact, whereby elasticity or flexion is obtained, is applied to any and every sort of cylinders, be they made of cold-drawn iron, steel, or other metal, or to cylinders made in any other manner.

The patentee claims, First—the transforming of muzzle-loading cannon, which have hitherto fired spherical shot, into cannon, to fire elongated projectiles, by inserting into the bores of such cannon a cylinder or cylinders, secured therein by a valve and nut, the parts being rendered air and gas-tight by a graphitic composition, as described. Second—the removing of a portion or portions of the inner surface of the cannon, or the outer surface of the cylinder or cylinders used in transforming smooth-bore cannon, which had hitherto been adapted to fire spherical shot, into cannon, to fire elongated projectiles; whereby the cylinder or cylinders do not wholly throughout their length come in contact with the inner surface of the outer shell or gun, in manner and for the purposes described.

To Richard Archibald Brooman, *of Fleet-street, for improvements in apparatus for feeding wool, and other textile and filamentous substances, into carding, combing, and other machines for treating such substances,—being a communication.*—[Dated 7th June, 1864.]

This invention consists in feeding, mechanically, as hereafter described, wool and other textile and filamentous substances, to carding, combing, and other machines for treating the same.

The figure in Plate X. shows the improved feeding apparatus, in section, as applied to a carding engine. B, is a hopper for receiving the wool or other material; C, is the endless travelling table, with teeth, spikes, or hooks. A roller may be substituted, if desired. D, is a rake, with a to-and-fro movement from E, to F. In moving from the point F, it takes into the teeth of the travelling table and the wool thereon; and before returning from the point E, it unhooks or releases the wool, which falls on the belt A, below. The rake is composed of two boards or plates 4, 5, between which is a plate 6, with teeth or hooks. When it arrives at the point E, the teeth entirely enter between the boards 4, 5, in order that they may not hold the wool when it arrives at the point F: the teeth project, because the guide

1, 2, 3, has compelled them to follow its direction. G, is a curved plate or board for guiding the wool which falls from the rake on to an endless travelling apron A, to be fed into the carding, combing, or other machine for treating the same.

In some cases, a comb H, is fitted below the endless travelling table C, for the purpose of releasing or unhooking the wool carried by the teeth of the table. This comb may be employed instead of, or in addition to, the rake D.

The patentee claims, "arranging apparatus for feeding wool, and other textile and filamentous substances, into carding, combing, and other machines for treating such substances, substantially as described."

To EDWARD GERRARD FITTON, *of Manchester, for certain improvements in or applicable to carding engines.*—[Dated 13th June, 1864.]

THIS invention relates to the bearings or fixings of the working rollers and clearers used in carding engines for carding cotton and other fibrous substances.

In Plate X., fig. 1 is an edge view of the bearing, with the end of the roller to be supported, and fig. 2 is a front view of the same. *a*, is the plate of the fixing or bearing, which is bolted in the usual manner to the bend of the carding engine: to the top of the plate *a*, is cast the projection *b*, extending from the bend to the end of the roller *c*: to the top of the plate *a*, is also cast the projection *d*, forming part of the hinge of the lid *e*, which lid, when closed, covers the axle and neck of the roller. By this means the loose fibres are excluded from the axle or bearing; consequently the waste is prevented, and the time heretofore spent in removing the fibres is economized: the rollers are also capable of being removed from their bearings with as much facility as when supported in bearings of the ordinary construction, as in removing the rollers from the carding engine for grinding or other purposes, the lids are opened, as shown by dotted lines in fig. 2.

The patentee claims, "the improved mode of constructing the bearings of the working rollers and clearers of carding engines, as shown and described."

To GEORGE COLES, *of Gresham-street West, and* JAMES ARCHIBALD JAQUES *and* JOHN AMERICUS FANSHAWE, *both of Tottenham, for improvements in the manufacture of bags, sacks, pouches, and other flexible articles of capacity.*—[Dated 11th October, 1864.]

THIS invention relates principally to a means of closing the neck, mouth, or entrance of india-rubber bags, sacks, pouches, and other flexible articles of capacity, by the natural elasticity of the material of which they are formed.

In Plate IX., various plans of applying the invention are shown to small articles,—such as purses, money-bags, tobacco-pouches, &c. The whole article may be formed of one piece of rubber properly moulded, or merely the mouth or entrance may be made of the elastic material. In order to form the self-closing mouth, the article is first moulded.

A moulding block of metal or hard rubber is then placed inside the article, as shown at *a*, in fig. 1, which represents a tobacco-pouch prepared ready for forming the self-closing mouth. A second block *b*, is then placed in the mouth while the rubber is in the crude or raw state, and a wire or string is passed round the neck of the bag, to secure it to the block *b*. The mouth part *c*, *c*, with the block *b*, secured therein, is then twisted forcibly round about one-third of a circle, and is held in this position between the dies or blocks *a*, and *b*, by means of tapes or bandages *d*, *d*, (as seen in fig. 2) while being cured or vulcanized. The effect of this will be, that the twisted folds or creases given to the rubber will remain permanent, so that when the mouth is opened and let go, it will instantly close itself.

Fig. 3 is a plan view of an India-rubber tobacco-pouch, constructed with a collapsible self-closing mouth, as above described. Fig. 4 is a side view thereof. Fig. 5 is a similar view, showing the mouth slightly raised, as if for the purpose of opening the pouch. The tendency of the mouth, when opened, to obtain access to the interior, is for it to resume the position and appearance shown in figures 3 and 4.

Figs. 6, 7, and 8 represent another form of pouch. In this instance the pouch is rectangular, and when open (as shown at fig. 6) there are four flat vertical sides. In making this pouch, an inner block is inserted, as in the former instance, to maintain the internal capacity of the article, and the collapsible self-closing mouth is made by folding down the sides, one after the other, commencing by bringing the point 1, (fig. 6) down to 2, thus producing a diagonal crease from 3 to 4, and following in with the other sides in the same manner, so as to produce the pouch shown in plan and side view at figs. 7 and 8. A rigid block is placed on the folded mouth, as in the former instance, so as to keep it in place while being vulcanized.

Fig. 9 is an end view, fig. 10 a plan view, and fig. 11 a sectional view, of a rectangular pouch, with a collapsible mouth, made by rolling up the edges of the mouth, instead of twisting them round. Fig. 9 shows the pouch closed, and with the mouth rolled up. Fig. 11 represents the mouth as unrolled, ready for obtaining access to the interior of the article. Figs. 12 and 13 are plan and side views of a pouch, the mouth of which is cut in vandykes, folded down, while the rubber is in an uncured state. The folded parts are kept in this position by suitable dies or blocks while the article is being cured. Fig. 14 is a plan view, and fig. 15 an edge view, of another form of pouch, which is closed by folding over the ends and sides. Fig. 16 is a plan view, showing the pouch open. It is closed by first folding over the two ends *e*, *e*, as indicated by dotted lines in fig. 16, and then folding down the sides *f*, *f*.

Figs. 17, 18, and 19 are side and end views of another form of tobacco pouch or cigar case. The mouth is made with an elastic piece or flap *i*, with flexible sides. In order to keep it in shape, a strip of metal, hard rubber, or cane is inserted in the edge of the mouth, as shown at *j*, and also in the edge of the elastic piece, as shown at *k*.

Fig. 20 is a side elevation, and fig. 21 is a horizontal section, of a cigar case, provided with a collapsible mouth-piece, made in the manner shown in figs. 3 and 4. Its compartments *m*, *m*, for containing cigars, are formed of sheet rubber, protected or stiffened by curved pieces of

perforated sheet metal, as shown at *l*. While the rubber is in the uncured state, the sides of the compartments *m*, *m*, are made adhesive, so that, when brought into contact, they will adhere together, and form the combined case. A bottom piece of rubber, of suitable shape, closes the lower ends of the compartments *m*, and the collapsible mouth is adapted to the upper end, and is formed in the manner already explained. Fig. 22 represents one of the elastic or collapsible mouths, made as shown in figs. 12 and 13, adapted to a rigid box *n*, formed of hard rubber, wood, or other suitable material.

Fig. 23 shows a collapsible or expanding receptacle, with folded sides, for containing wearing apparel. The mouth or entrance to the receptacle may be formed according to any of the plans above described, but, by preference, either the plan shown at fig. 6, or that shown at fig. 14, may be employed. The expanding receptacle may be enclosed within a flexible outer case, as shown, or within a rigid case, or it may form a package by itself, or it may be adapted to the upper part of a rigid receptacle, so as to form an expanding receptacle.

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

March 14th, 1865.

J. R. McCLEAN, Esq., President, in the Chair.

The paper read was, "*On the Metropolitan System of Drainage, and the Interception of the Sewage from the River Thames,*" by Mr. J. W. Bazalgette, M. Inst. C.E.

Before proceeding to describe the modern works for the drainage of London, which, even prior to the introduction of the improved system, was probably the best drained city of the present age, the author glanced at the early history of its sewerage. The minutes of the ancient Westminster Commissions of Sewers contained records of peculiar interest, showing, amongst other things, that improvements for drainage were effected under the advice and instructions of Sir Christopher Wren, nearly two hundred years ago, and that the Commissioners of Sewers, in the reign of Charles II., and subsequently, interfered to regulate the proceedings for the drainage of the Royal Palace in St. James's Park. Sketches attached to the paper represented the condition and appearance of some of the main valley lines—as the Fleet Sewer, the Tye Bourne and the Bayswater Brook (now called the Ranelagh Sewer), and the King's Scholar's Pond Sewer—taken from actual surveys in 1809. Up to about the year 1815, it was penal to discharge sewage or other offensive matters into the sewers; cesspools were regarded as the proper receptacles for house drainage, and sewers as the legitimate channels for carrying off the surface waters only. As the population of London increased, its subsoil became

thickly studded with cesspools, improved household appliances were introduced, and, it having become permissive, overflow drains from the cesspools to the sewers were constructed; thus the sewers became polluted, and covered brick channels were necessarily substituted for existing open streams. These works, prior to the year 1847, when the first act was obtained, making it compulsory to drain houses into sewers, being under the direction of eight distinct commissions, each appointing its own officers, were not constructed upon a uniform system; and the sizes, shapes, and levels of the sewers at the boundaries of the different districts were often very variable. Larger sewers were made to discharge into smaller ones, sewers with upright sides and circular crowns and inverts were connected with egg-shaped sewers, or the latter, with the narrow part uppermost, were connected with similar sewers, having the smaller part downwards. In the year 1847, these eight commissions were superseded by "The Metropolitan Commission of Sewers," whose members were nominated by the government. That commission directed its energies mainly to the introduction of pipe sewers of small dimensions in lieu of the large brick sewers previously in vogue, to the abolition of cesspools, and to the diversion of all house drainage, by direct communications into the sewers, making the adoption of the new system of drainage compulsory; so that, within a period of about six years, thirty thousand cesspools were abolished, and all house and street refuse was turned into the river. Similar systems were, about the same period, to a large extent, adopted in the provincial towns, by which means their drainage had become much improved, but the rivers and streams of this country had been seriously polluted. Within nine years, "The Metropolitan Commission of Sewers" was followed by six new and differently constituted commissions, whose labours were duly recorded; but they were unable, during the limited period of their existence, to mature and carry out works of any magnitude. However, the subject of the purification of the Thames, then becoming full of sewage, received much consideration; and the late Mr. R. Stephenson, Mr. Rendel, and Sir W. Cubitt, who were members of the third commission, reported upon one hundred and sixteen competing plans, having that object in view, arriving at the conclusion, that none were such as could be recommended for execution. In 1850, the late Mr. Frank Forster was appointed chief engineer of the commission, and, under his direction, Messrs. Grant and Cresy commenced the preparation of a plan for the interception of the sewage of the area south of the river, and Mr. Haywood, engineer to the City Commissioners of Sewers, assisted Mr. Forster in making a similar plan for the districts on the north side. In 1852, the fifth commission was issued, and the author became the chief engineer on the death of Mr. Forster. Two years later, the author was directed to prepare a scheme of intercepting sewers, intended to effect the improved main drainage of London, and Mr. Haywood was associated with him for the northern portion. The plan so prepared subsequently received the approval of the late Mr. R. Stephenson and Sir W. Cubitt, and was recommended for adoption.

In the year 1856, the present Metropolitan Board of Works was formed—being the first application, in the metropolis, of the system of local self-government. The author, having been appointed engineer to

the board, was instructed to prepare a plan for the main drainage, in which it was essential that ample means should be provided for the discharge of the large and increasing water supply consequent on the universal adoption of closets, and of the ordinary rainfall and surface drainage at all times, except during extraordinary floods; and that it should afford to the low-lying districts a sufficiently deep outfall to allow of every house being effectually relieved of its fluid refuse. The objects sought to be attained by these works, now practically complete and in operation, were the interception, as far as practicable, by gravitation, of the sewage, together with so much of the rain-fall mixed with it as could be reasonably dealt with, so as to divert it from the river near London; the substitution of a constant instead of an intermittent flow in the sewers; the abolition of stagnant and tide-locked sewers, with their consequent accumulations of deposit; and the provision of deep and improved outfalls, for the extension of sewerage into districts previously, for want of such outfalls, imperfectly drained. Prior to these works being undertaken, the London main sewers fell into the valley of the Thames, and the sewage was discharged into the river at the time of low water. In the system now adopted, it had been sought to remove the evils thus created, by the construction of new lines of sewers, at right angles to the existing sewers, and a little below their levels, so as to intercept their contents and convey them to an outfall 14 miles below London-bridge. As large a proportion of the sewage as practicable was thus carried away by gravitation, and for the remainder a constant discharge was effected by pumping. At the outlets the sewage was delivered into reservoirs on the banks of the Thames, placed at such a level as would enable them to discharge into the river at or about the time of high water. By this arrangement, the sewage was not only at once diluted by the large volume of water at high tide, but it was also carried by the ebb to a point 26 miles below London-bridge, and its return by the following flood tide within the metropolitan area was effectually prevented.

The points which required solution at the threshold of the inquiry, then successively noticed, were:—

1. At what state of the tide could the sewage be discharged into the river so as not to return within the more densely inhabited portions of the metropolis?
2. What was the minimum fall which should be given to the intercepting sewers?
3. What was the quantity of sewage to be intercepted, and did it pass off in a uniform flow at all hours of the day and night, or in what manner?
4. Was the rainfall to be mixed with the sewage, in what manner and quantities did it flow into the sewers, and was it also to be carried off in the intercepting sewers, or how was it to be provided for?
5. Having regard to all these points, how were the sizes of the intercepting and main drainage sewers to be determined? and
6. What description of pumping engines and pumps were best suited for lifting the sewage of London at the pumping stations?

As regarded the position of the outfalls and the time of discharge, an extract was given from the Report of the late Mr. Robert Stephenson and Sir William Cubitt, dated the 11th December, 1854, referring to a series of experiments made with a float, by the late Mr. Frank Forster, and subsequently repeated by Captain Burstal, R.N., and the author, which proved that it was essential to go as far as Barking Creek, and that the discharge should take place at or near to high water. These experiments also demonstrated, that "the delivery of the sewage at high water into the river at any point is equivalent to its discharge at low water at a point 12 miles lower down the river; therefore the construction of 12 miles of sewer is saved, by discharging the sewage at high instead of at low water."

With respect to the velocity of flow and the minimum fall, it was difficult to lay down any general rule, because the conditions of sewers. as to the quantity of deposit and the volume of sewage, varied considerably; but the results arrived at by Mr. Wicksteed, Mr. Beardmore, Mr. John Phillips, and Professor Robison, were quoted, in confirmation of the author's own observations and experience, which led him to regard a mean velocity of 1½ mile per hour, in a properly protected main sewer, when running half full, as sufficient, especially when the contents had previously passed through a pumping station. Having thus determined the minimum velocity, it became necessary to ascertain the quantity of sewage to be carried off, before the fall requisite to produce that velocity could be estimated. That quantity varied but little from the water supply; and as it was contemplated that 31¼ gallons per head per diem might be supplied to a district, of average density of population, containing 30,000 people to the square mile, except in outlying districts, where the number of inhabitants was reckoned at 20,000 per square mile; and as actual measurements showed that provision for one-half of the sewage to flow off within six hours of the day would be ample, the maximum quantity of sewage likely hereafter to enter the sewers at various points of the metropolis had been arrived at.

It had been advocated, by theorists, that the rainfall should not be allowed to flow off with the sewage, but be dealt with by a separate system of sewers. This would have involved a double set of drains to every house, and the construction and maintenance of a second series of sewers in every street, at an expenditure of from ten to twelve millions sterling, at the least, besides the inconvenience.

Having ascertained the quantities of sewage and of rainfall to be carried off, and the rate of declivity of the sewer as limited only by considerations of the necessary velocity of flow, the sizes of the intercepting sewers were readily determined by the formulæ of Prony, Eytelwein, and Du Buat, and the drainage sewers by the useful formula of Mr. Hawksley, which it was said, in the report of the late Mr. R. Stephenson and Sir W. Cubitt, already referred to, were "applicable to almost every variety of condition which the complete drainage of large towns involves."

In regard to the sixth and last head of the inquiry in 1859, numerous competing designs, involving the comparative advantages of Cornish or rotative engines, and the respective merits of centrifugal and screw pumps, chain pumps, lifting bucket wheels, flash wheels, and every

variety of suction or plunger pump and pump valve, for raising the metropolitan sewage, were reported upon by Messrs. Stephenson, Field, Penn, Hawksley, Bidder, and the author. Based upon the recommendations contained in that report, condensing double-acting rotative beam engines, and plunger or ram pumps, had been adopted; the sewage being discharged from the pumps through a series of hanging valves. The contractors for the engines at Crossness and at Abbey Mills had guaranteed that they should, when working, raise 80 million lbs. one foot high with one cwt. of Welsh coal.

It had already been stated that a primary object sought to be attained by these works was, the removal of as much of the sewage as possible by gravitation, so as to reduce the amount of pumping to a minimum. To effect this, three lines of sewers had been constructed on each side of the river, termed respectively the high level, the middle level, and the low level. The high and the middle level sewers on both sides discharged by gravitation, but for the two low level sewers the aid of pumping was necessary. The three lines of sewers north of the Thames converged to, and were united at, Abbey Mills, east of London, where the contents of the low level sewer would be pumped into the upper level sewer; the aggregate stream would thence flow through the northern outfall sewer, which was carried in a concrete embankment across the marshes to Barking Creek, where the sewage was discharged into the river by gravitation. On the south side the three intercepting lines united at Deptford Creek, and the contents of the low level sewer were there pumped to the upper level, whence the three streams would flow in one channel through Woolwich to Crossness Point, in Erith Marshes. Here the whole mass of the sewage could flow into the Thames at low water, but would ordinarily be raised by pumping into the reservoir.

As the intercepting sewers carried off only 1-100th part of an inch of rain in an hour, and the volume of sewage passing through them was at all times considerable, the flow through these sewers was more uniform than in drainage sewers constructed to carry off heavy rain storms. The form therefore generally adopted for the intercepting sewers was circular, as combining the greatest strength and capacity with the smallest amount of brickwork and the least cost. In the minor branches, for district drainage, the egg-shaped sewer, with the narrow part downwards, was preferable; because the dry weather flow of the sewage being very small, the greatest hydraulic mean depth, consequently the greatest velocity of flow and scouring power, was obtained by that section in the bottom of the sewer, at the period when it was most required; and the broader section at the upper part allowed room for the passage of the storm waters, as also of the workmen engaged in repairing and cleansing these smaller sewers.

A more detailed description was then given of the several works, and of some of the peculiarities or difficulties met with during their construction.

On the north side of the Thames, the high level sewer varied in size from 4 feet in diameter to 9 feet 6 inches by 12 feet. Its fall was rapid, ranging at the upper end from 1 in 71 to 1 in 376, and at the lower end from 4 to 5 feet per mile. In its construction, much house property was successfully tunnelled under at Hackney. Adjoining the railway

station, a house was underpinned and placed upon iron girders, and the sewer, being there 9 feet 3 inches in diameter, was carried through the cellar. This sewer also passed close under Sir George Duckett's canal; the distance between the soffit of the arch of the sewer and the water in the canal being only 24 inches. The bottom of the canal and the top of the sewer were here formed of iron girders and plates with a thin coating of puddle, and no leakage had taken place. The penstock and weir chamber, at the junction of the high and middle level sewers at Old Ford, Bow, placed three-fourths of the northern sewage completely under command. It was built in brickwork, was 150 feet in length by 40 feet in breadth, and was, in places, 30 feet in height, The principal difficulties in the prosecution of these works arose from combinations and strikes amongst the workmen; and from a long-continued wet season, preventing the manufacture of bricks; as well as from the great increase in the prices of building materials and of labour.

The middle level sewer was carried as near to the Thames as the contour of the ground would permit, so as to limit the low level area, which was dependent upon pumping, to a minimum. The district intercepted by this sewer was 17¼ square miles in extent, and was densely inhabited. The length of the main line was about 9½ miles, and of the Piccadilly branch 2 miles. The fall of the main line varied from 17½ feet per mile at the upper end to 2 feet per mile at the lower end. The sizes of this sewer ranged from 4 feet 6 inches by 3 feet, to 10 feet 6 inches in diameter, and, lastly, to 9 feet 6 inches by 12 feet at the outlet. About 4 miles of the main line, and the whole of the Piccadilly branch, were constructed by tunnelling under the streets, at depths varying from 20 to 60 feet. This sewer was formed mostly in the London clay; but to the east of Shoreditch the ground was gravel. During the execution of the works under the Regent's Canal, the water burst in; but by enclosing one-half of the width of the tunnel at a time within a coffer-dam, and then by open cutting, the sewer was subsequently completed. The middle level sewer was carried over the Metropolitan railway by a wrought-iron aqueduct, 150 feet span, weighing 240 tons. The depth between the under side of the aqueduct and the inverts of the double line of sewers was only 2¼ inches; and as the traffic of the railway could not be stopped during the construction of the aqueduct, which was designed to be only a few inches above the engine chimnies, the structure was built upon a stage at a height of 5 feet above its intended level, and was afterwards lowered into its place by hydraulic rams. The sewers were here formed of wrought-iron plates, rivetted together. The middle level sewer was provided with weirs, or storm overflows, at its various junctions with all the main valley lines.

The length of the main line of the low-level sewer was 8¼ miles, and its branches were about 4 miles in length. Its size varied from 6 feet 9 inches to 10 feet 3 inches in diameter, and its inclination ranged from 2 to 3 feet per mile; it was provided with storm overflows into the river. As well as being the intercepting sewer of the low level area, which contained 11 square miles, it was the main outlet for the drainage of the western suburb of London, a district of about 14½ square miles, which was so low, that its sewage had to be lifted at Chelsea, a height of 17½ feet, into the upper end of the low-level sewer. It was origi-

nally intended to deodorise or utilise the sewage of the western division in its own neighbourhood, rather than to incur the heavy cost of conveying it to Barking, and lifting it twice on its route to that place. But strong objections having been raised to this, the latter and more costly plan had been adopted. The works of this division were executed mainly through gravel, charged with such large volumes of water, that it was necessary to lay stoneware pipes under the inverts of the sewers, to lower the water in the ground, and to convey it to numerous steam pumps before the sewers could be built.

The northern outfall sewer was a work of peculiar construction: for, unlike ordinary sewers, it was raised above the level of the surrounding neighbourhood, in an embankment, which was of sufficient strength to carry a roadway, or a railway, on the top, should it ever be required to do so, as was not improbable. Rivers, railways, streets, and roads, on the line of this sewer, were crossed by aqueducts. The North Woolwich and the Barking Railways were lowered, to enable the sewer to pass over them; for the sewer, being reduced to a minimum uniform fall of 2 feet per mile, could not be raised or depressed like a railway, to accommodate its levels to those of previously existing works. This constituted one of the chief difficulties in laying out the outfall sewer, for the district was already closely intersected by public works.

The Barking reservoir had an average depth of $16\frac{1}{4}$ feet, and was divided by partition walls, into four compartments, covering together an effective area of about $9\frac{1}{2}$ acres. The ground over which it was built, being unfit to sustain the structure, the foundations of the piers and walls were carried down, in concrete, to a depth of nearly 20 feet. The external and partition walls were of brickwork, and the entire area was covered by brick arches, supported upon brick piers, the floor being paved throughout with York stone.

The Abbey Mills pumping station—the largest of the kind on the main drainage works—was furnished with engines of 1140 collective horse-power, for the purpose of lifting a maximum quantity of sewage and rainfall of 15,000 cubic feet per minute, a height of 36 feet. This station alone would consume about 9700 tons of coal per annum: but the cost of pumping was not entirely in excess of former expenditure upon the drainage; for the removal of the deposit from the tide-locked and stagnant sewers in London previously led to an outlay of about £30,000. The substitution of a constant flow through the sewers, now rendered possible, must necessarily largely reduce the deposit, and, consequently, the expense of cleansing.

On the south side of the Thames, the high-level sewer, and its southern branch, corresponding with the high and middle level sewers on the north side of the river, together drained an area of about 20 square miles. Both lines were of sufficient capacity to carry off all the flood waters, so that they might be entirely intercepted from the low and thickly-inhabited district, which was tide-locked and subject to floods. The main line varied in size from 4 ft. 6 in. by 3 feet at the upper end, to a form 10 ft. 6 in. by 10 ft. 6 in. at the lower end, the latter having a circular crown and segmental sides and invert; its fall ranged from 53, 26, and 9 feet per mile to the Effra, and thence to the outlet it was $2\frac{1}{2}$ feet per mile. The branch line was $4\frac{1}{2}$ miles in length; its

size varied from 7 feet in diameter to 10 feet 6 inches by 10 feet 6 inches, of the same form as the main line, by the side of which it was constructed. It had a fall of 30 feet per mile at the upper end, and of $2\frac{1}{3}$ feet per mile at the lower end.

The low-level sewer drained a district of 20 square miles. The surface of this area was mostly below the level of high water, and was, in many places, 5 or 6 feet below it, having at one time been completely covered by the Thames. The sewers throughout the district had but little fall, and, excepting at the period of low water, were tide-locked and stagnant; consequently, after long-continued rain, they became overcharged, and were unable to empty themselves during the short period of low water. The want of flow also caused large accumulations of deposit in the sewers, the removal of which was difficult and costly. These defects, added to the malaria arising from the stagnant sewage, contributed to render the district unhealthy; and it was with reference to its condition, that the late Mr. R. Stephenson and Sir W. Cubitt so forcibly described the effect of artificial drainage by pumping, as equivalent to raising the surface a height of 20 feet. The low-level sewer had rendered this district as dry and healthy as any portion of the metropolis. Its length was about 10 miles, and its size varied from a single sewer, 4 feet in diameter at the upper end, to two culverts, each 7 feet by 7 feet at the lower end, their fall ranging from 4 to 2 feet per mile. The lift at the outlet of the sewer was 18 feet. Much difficulty was experienced in executing a portion of this work, close to and below the foundations of the arches of the Greenwich Railway and under Deptford Creek, owing to the immense volume of water there met with. This was, however, at last surmounted, by sinking two iron cylinders, each 10 feet in diameter, through the sand to a depth of about 45 feet, the water being kept down by pumping at the rate of from 5000 to 7000 gallons per minute. The sewer was carried under Deptford Creek, and the navigation was kept open, by constructing a coffer-dam into the middle of the creek, and executing one-half of the work at a time.

The Deptford Pumping Station, where the sewage was lifted from the Low Level Sewer into the Outfall Sewer, was provided with four condensing rotative beam engines, each of 125 H.P., and capable together of raising 10,000 cubic feet of sewage per minute, a height of 18 feet.

The Southern Outfall Sewer conveyed the sewage which flowed into it from the High Level Sewer, by gravitation, through four iron culverts laid under Deptford Creek; and that which was pumped into it from the Low Level Sewer, from Deptford through Greenwich and Woolwich to Crossness Point in the Erith Marshes. It was entirely underground for its whole length, $7\frac{3}{4}$ miles, was 11 feet 6 inches in diameter, and had a fall of 2 feet per mile.

The Crossness Reservoir, which was $6\frac{1}{2}$ acres in extent, was covered by brick arches supported on brick piers, and was furnished with overflow weirs and with a flushing culvert. Its height, level, and general construction were similar to that at Barking Creek. The ground upon which these works were constructed consisted of peat and sand, or soft silty clay, and afforded no sufficient foundation within 25 feet of the surface. The outlet of the Southern Outfall Sewer was ordinarily

closed by a penstock, and its contents were raised by pumping into the reservoir, which stored the sewage, except for the two hours of discharge after high water. The sewage was thus diverted from its direct course to the river into a side channel leading to the pump well, which formed part of the foundation for the engine-house. From this well it was lifted by four high-pressure condensing rotative beam engines, each of 125 H.P., actuating, direct from the beam, two compound pumps, each having four plunger.

The tunnelling, and the formation of the sewers through quicksands charged with large volumes of water, under various portions of the metropolis, more particularly in the low-lying districts on the south side of the Thames, were rendered practicable and safe by a mode of pumping the water out of the ground, without withdrawing the sand, which was adopted and perfected during the progress of the works. The method was to sink, in some convenient position near to the intended works, a brick well, to a depth of 5 or 6 feet below the lowest part of the excavation. In some cases, where the depth was great, an iron cylinder was sunk below the brickwork, and the bottom and sides of the well were lined with shingle, which filtered the water passing into it, and exposed a large surface of this filtering medium. Earthenware pipes were carried from this well and laid below the invert of the intended sewer, small pits being formed at the mouths of these pipes, to protect them from the deposit. By these means, the water had been successfully withdrawn from the worst quicksands, and they had been rendered firm and dry for building on. The effectual backing of the invert and haunches with concrete formed, in such treacherous ground, it was asserted, the cheapest and the best foundation.

There were about 1300 miles of sewers in London, and 82 miles of main intercepting sewers. The total pumping power employed was 2380 nominal H.P., with an average estimated consumption of 20,000 tons of coal per annum. The sewage on the north side of the Thames at present amounted to 10 million cubic feet per day, and on the south side to 4 million cubic feet per day; but provision was made for an anticipated increase up to 11½ and 5¾ million cubic feet per day respectively, in addition to a rainfall of 28½ and 17¼ million cubic feet per day respectively, or a total of 63 million cubic feet per day.

The total cost of the main drainage works would be about £4,100,000. The works had been executed under the immediate superintendence of the assistant engineers, Messrs. Lovick, Grant, and Cooper. The principal contractors had been Messrs. Brassey, Ogilvie, and Harrison, Mr. Webster, Mr. Furness, Messrs. Aird and Sons, Mr. Moxon, Messrs. James Watt and Co., Messrs. Slaughter, and Messrs. Rothwell and Co. The works were now completed, with the exception of the low-level sewer on the north side of the river, which was being formed in connection with the Thames Embankment and the new street to the Mansion House, and would therefore, probably, not come into operation for a couple of years. The proportion of the area drained by that sewer was one-seventh of the whole. Some sections of the works had been in operation from two to four years, and the largest portion for more than one year; so that the principles upon which they were based had already been fairly tested.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

At recent meetings of this Society, the following, among other interesting papers of a less practical character, were read:—

"*On the Action of Sea Water upon certain Metals and Alloys,*" by F. Crace Calvert, Ph.D., F.R.S., F.C.S., &c., and R. Johnson, F.C.S.

We were induced to examine the action exerted by sea water, in consequence of the rapid changes which have taken place of late years in naval architecture, and especially in the substitution of metals and alloys for wood.

To carry out the above views, we took 20 square centimetres of each metal, which we cleaned with great care and attention, in order that the action of the sea water might have its full effect; then two plates of each metal were placed in separate glass vessels, and immersed in equal volumes of sea water. After one month the plates were taken out, and any compounds that had adhered to the surface carefully removed; the plates were then dried and re-weighed, and the loss estimated. To render our results of more practical value, we have calculated the action of 100 litres of sea water upon one square metre of each metal, and the following are the amounts of metals dissolved:—

	Grammes.
Steel	29·16
Iron	27·37
Copper (best selected)	12·96
Copper (rough cake)	13·85
Zinc	5·66
Galvanized Iron	1·12
Block Tin	1·45
Stream Tin	1·45
Lead (virgin)	Trace.
,, (common)	Trace.

These results appear to us to lead to the following conclusions:—

1. That the metal now most in vogue for shipbuilding, namely, iron, is that which is most readily attacked.

2. That this metal is most materially preserved from the action of sea water when coated with zinc; and therefore, in our opinion, it would amply repay shipbuilders to use galvanised iron as a substitute for that metal itself.

The above facts perfectly confirm those which we have already published, which show that when iron was in contact with oak, they mutually acted upon each other, producing a rapid destruction of the two materials, whilst little or no action took place between galvanised iron and the wood.

3. The extraordinary resistance which lead offers to the action of sea water, naturally suggests its use as a preservative to iron vessels against the destructive action of that element; and although we are aware that pure lead is too soft to withstand the wear and tear which ships' bottoms are subjected to, still we feel that an alloy of lead could be devised which would meet the requirements of shipbuilders.

Feeling that experiments made with a limited amount of sea water

might not be a fair criterion of the action of the ocean upon metals, we repeated our experiments upon plates of 40 centimetres square, which were immersed for one month in the sea on the western coast (Fleetwood), taking the precaution that they should be constantly beneath the surface of the water, and suspended by flax rope attached to a wooden structure, to prevent any galvanic action taking place between the plates and the structure to which they were attached.

The following are the amounts of metals dissolved:—

	Grammes.
Steel	105·31
Iron	99·30
Copper (best selected)	29·72
Zinc	34·34
Galvanized Iron	14·42
Lead (virgin)	25·69
„ (common)	25·85

The above figures suggest the following remarks:—

That the action has been much more intense, in this instance, than when the metals were placed in a limited amount of water in the laboratory. These results are due, probably, to several causes acting at the same time, viz.:—that the metal was exposed to the constantly renewing surface of an active agent; and that there was also a considerable friction exerted on the surface of the plate by the constant motion of the water, there being at Fleetwood a powerful tide and rough seas. What substantiates this opinion is, that the lead plates undoubtedly lost the greater part of the weight, not by the solvent action of the sea water, but from particles of lead detached from them, in consequence of their coming in contact with sand and the wooden supports to which they were attached; but this cause of destruction having been observed with lead plates, it was afterwards carefully guarded against in the case of all the other metal plates.

We also deemed it desirable to examine the action of sea water on various brasses. We therefore immersed, for one month, plates of various alloys in that fluid, and proceeded to record our results:—

Action of 200 Litres of Sea Water upon 1 Square Metre Surface of the following Brasses:—

Composition of the Brasses.		*Quantity of Metal Dissolved.* Iron.	Copper.	Zinc.	Total.
Pure Copper	50				
Pure Zinc	50				
	100	——	1·110	10·537	11·847
Commercial Brass:—					
Copper	66·				
Zinc	32·5				
Iron and Lead	1·5				
	100	0·579	3·667	3·324	7·570
Muntz Metal (Sheet):—					
Copper	70·				
Zinc	29·2				
Iron and Lead	0·8				
	100·0	0·488	4·226	2·721	7·385

Muntz Metal (Bars):—					
Copper	62				
Zinc	37				
Lead and Iron	1				
	100·0	... 0·501	... 2·697	... 3·493	... 6·691
Prepared Brass:—					
Copper	50				
Zinc	48				
Tin	2	TIN.			
	100	... 0·365	... 7·04	... 3·477	... 10·882

The above table shows how very differently sea water acts upon divers brasses, and the influence exercised upon the copper and the zinc composing them, by the existence in them of a very small proportion of another metal: thus, in pure brass, the zinc is most rapidly dissolved—which, *en passant*, is the contrary to what takes place in galvanised iron—whilst it acts as a preservative to the copper.

Tin, on the other hand, appears to preserve the zinc, but to assist the action of sea water upon the copper.

The great difference between the action of sea water upon pure copper and upon Muntz metal seems to us to be due not only to the fact that copper is alloyed to zinc, but to the small proportion of lead and iron which that alloy contains; and there can be no doubt that shipbuilders derive great benefit by using it for the keels of their vessels.

We were so surprised at the inaction of sea water upon lead, that we were induced to compare its action with that of several distinct varieties of water—viz., Manchester Corporation water, well water, distilled water in contact with air, the same deprived of air: and the following are the amounts of metals dissolved by 200 litres of these waters upon one square metre of surface during eight weeks.

	Grammes.
Manchester Corporation Water	2·094
Well Water	1·477
Distilled Water (with air)	110·003
,, ,, (without air)	1·829
Sea Water	0·038

These figures require no comment, as they confirm our previous result that sea water has no action on lead.

Mr. John Robinson exhibited specimens of iron and brass, which had been acted upon by the water of the river Medlock; and stated he had found that an alloy of lead, tin, and antimony resisted the action of sea water better than any other metal or alloy he had tried.

"*The Injurious Action of Alkalies on Cotton Fibre*," by Messrs. Heinrich Caro and William Dancer.

A remarkable instance of the deleterious action of alkali on cotton fibre lately came under our notice, when examining some indigo prints, which had been stiffened or finished with silicate of soda, and

kept in bales during about two years. The strength of the fibre of the greater part of these goods had decreased to about one-third of the strength of some pieces which had been packed in the same bales, and which differed in no other respect from the others, except in their having been finished with starch. We, therefore, surmised that silicate of soda had been the primary cause of the deterioration of the goods. Further observations convinced us, however, that the injury was due to the long-continued action of free or carbonated alkali upon the cotton fibre.

Some of the sound pieces (which, as before mentioned, had been finished with starch) had been packed between the silicated goods, and had abstracted soda from them which had penetrated from the places of contact into the interior of the pieces to a considerable depth. In the same ratio in which the pieces had taken up soda, it was found that they had diminished in strength. On the other hand, it was found that, in such places of contact, the silicate of soda of the silicated goods had suffered a partial decomposition, extending to the depth of four or five layers of the pieces. The silicate of soda in the middle of the pieces contained from 70 to 74 per cent of silicic acid, combined with from 30 to 26 per cent. of soda; whilst the analysis of the silicate of soda contained in the contact layers, showed that from one-third to two-thirds of its soda had been abstracted. This loss of soda was accompanied by a change of strength of the cloth which appeared to bear some proportion to it; the layers or folds of the cloth *decreasing* in strength as they were removed from contact with the starched goods until the silicate of soda attained the same composition as that found in the most rotten parts of the piece, this generally taking place about the fourth or fifth layer or fold of the piece, as before stated.

The following table shows the change in strength produced by this decomposition of the silicate of soda:—

	Finished with Starch.		Finished with Silicate of Soda.					
	Middle.	Contact Layer.	Contact Layer.	2nd.	3rd.	4th.	5th.	Middle.
Strength	100	81	89	68	62	54	48	35

The silicate of soda had evidently been decomposed with the formation of free alkali and an acid silicate, which appears to have very little action on the cotton fibre.

In some places the decomposition had gone further, and free silicic acid had separated out in the form of a white powder upon the surface of the cloth. The same decomposition, accompanied by the same changes in the strength of the cloth, was observed upon all pieces which had been in contact with the paper used for wrapping the bales. In this instance the paper had absorbed the liberated soda, and the cloth in contact with it had almost entirely retained its original strength.

The white portions of the patterns were in a further advanced state of decay than the blue ones, in most instances retaining only 10 per cent. of their original strength. In the goods finished with starch only the whites were equally as strong as the blues. In the goods finished

with silicate of soda, the whites were almost as strong as the blues in all places where the before-mentioned decomposition of the silicate of soda had been accompanied by an abstraction of soda; but in the interior of the goods, where the silicate of soda had retained its original composition, the strength of the whites had decreased to about one-third of that of the blues. It was therefore evident that this excessive decay of the whites was due to some cause which had assisted the action of the alkali upon them; and we believe to have found an explanation of this in the action of the silicate of soda upon the sulphate of lead contained in them to the amount of about 10 per cent. of the mineral ash.

Sulphate of lead has been an ingredient of the resist paste printed upon the places intended to remain white, and by the subsequent action of lime and sulphuric acid it has become fixed in the fibre. We have noticed that sulphate of lead decomposes solutions of silicate of soda very rapidly, with formation of sulphate of soda, free silicic acid, and silicate of lead.

These changes give rise to the production of a crystallisable and strongly efflorescent salt, and to an increase in bulk; and we think that the mechanical effect produced by the crystallisation of the sulphate of soda formed may have caused a further and final disintegration of the fibre already weakened by the action of the alkali. Under the microscope the fibre of the white portions of the pattern presented the appearance of *cylindrical* tubes, partially covered with minute crystals (soluble in water); in some places these tubes appeared to be split longitudinally.

Scientific Adjudication.

VICE-CHANCELLOR'S COURT.

(*Before Vice-Chancellor* SIR W. P. WOOD.)

NEEDHAM AND KITE *v.* OXLEY.

THIS was a motion to commit the defendant to prison for contempt of court, by his alleged breach of an injunction awarded against him, pursuant to an order made by the court, dated the 24th of June, 1863, by manufacturing and selling machines alleged to be infringements of the plaintiffs' patent, dated July 14th, 1853. The trial of the cause in 1863 is reported in Vol. XVIII., New Series, p. 44, of this journal. On the present occasion the counsel for the plaintiffs were Sir Hugh Cairns, Q.C., Mr. Hindmarch, Q.C., Mr. Bagshawe, and Mr. Needham (of the Common Law bar). For the defendant, Mr. Giffard, Q.C., Mr. Aston (of the Common Law bar), and Mr. Langworthy.

The question raised on this motion was in reality that of infringement of the patent, as will appear on reference to the opening part of the judgment. On the part of the plaintiffs it was contended that their patent consisted essentially of a high-pressure filter, in which the filtra-

tion was effected by internal pressure alone; such pressure being exerted in thin chambers, so arranged and held together that the pressure of one chamber reacted on and supported another chamber, and also so arranged that the chambers might be detached from the framework of the filter, and thus be separately and conveniently fitted with the filtering cloths, or discharged of their contents, as the case might require. And it was further contended, on behalf of the plaintiffs, that the machine made and sold by the defendant was constructed according to the plaintiffs' patented invention, with colourable differences only. That is to say, the chambers in the defendant's machine were alleged to correspond with the thin chambers described in the plaintiffs' specification, because the former, although differing in form, were caused to act in the same manner as the latter when used in combination. Also, the arrangement of the chambers, so as to admit of their ready detachment from the framework, was alleged to be substantially the same in the defendant's machine as in the plaintiffs' invention; the only difference between them in this respect being that, whereas the plaintiffs released their chambers by loosening their strong outer retaining frame, the defendant did this by means of a collapsible internal block or core, the loosening of which released the chambers. It was contended that while the plaintiffs' mode of releasing the chambers was by an external process, that of the defendant was by an internal process—the one being only a mechanical equivalent for the other.

On behalf of the defendant it was denied that the plaintiffs' invention, as held by the Vice-Chancellor to be described in his specification, included thin chambers, except as formed by equally thin slabs kept apart by intervening laths or filling-in pieces; such chambers being combined, so that the pressure in one chamber would be balanced by the pressure in the chamber on each side of it—the pressure on each side being ultimately transferred to, and resisted by, the rigid outer frame at each end of the series of comparatively flexible slabs. It was contended that it was only in this limited sense that the combination which was held to be described and claimed in the plaintiffs' specification included thin chambers; even the word "thin" being a word of definition not used in the specification, and only admissible by reference to the drawings, which showed the slabs and intervening chambers to be of like dimensions. It was also contended that the only mode of releasing the chambers indicated in the plaintiffs' specification was by loosening the outer frame.

As to the chambers in defendant's machine, it was contended that each chamber (or enclosure in which a filtering cloth was inserted) was contained between two rigid walls capable of resisting the pressure within the chamber, it being resisted on one side by the side of the cylinder surrounding the chamber, and on the other by a rigid internal block or core, so that the chambers did not depend upon each other for mutual support,—each chamber being capable of being worked independently of the other.

And as to the mode of releasing the chambers in defendant's machine. by means of an internal collapsible block or core, it was contended that it differed from plaintiffs' moveable external frame, inasmuch as it consisted in moving the boundary on one side of the chamber only, while the boundary on the other side thereof was permanently rigid; whereas,

in the plaintiffs' invention, each chamber of a series was opened on both sides, or had both its boundaries moved or loosened in a lateral direction.

The arguments of counsel were supported by the affidavits of scientific witnesses on both sides, and the machines, both of the plaintiffs and defendant, were submitted to the inspection of the court.

The details of the case will appear in the following

JUDGMENT.

The VICE-CHANCELLOR.—This is a case which required a good deal of consideration to be given to it. The motion is to commit the defendant, Mr. Oxley, for a breach of an injunction granted by decree, restraining him from evading the patent of the plaintiff. I must look upon it, of course, just as if, independent of the question of injunction at the present moment, and the contempt of court, it were an action brought against Mr. Oxley for infringing the plaintiffs' patent, and an action in which the plaintiffs' rights have not been established, except upon the question of infringement. Looking at it in that point of view, I confess I have a difficulty created by the defendant's own course of procedure, and his own patent, in a great measure, in regard to the instrument that he has now produced, and which he contends is not in any way an infringement of the plaintiff's patent. As regards the plaintiff's patent, this must be borne in mind, that it is a patent in which the plaintiff very properly disclaims the originality of any one part of the whole invention. He says—"As our invention applies to the expression of moisture from all substances capable of being so treated, it is obvious that alterations of some parts of the machinery or apparatus shown and described will be requisite (as when sewerage or large bodies of matter are to be operated upon); but those extensions or alterations may be made without departing in any way from the principle of our invention, as they will be confined to the enlargement, or contraction, of the various parts of the apparatus or machinery hereinbefore described and illustrated in the drawing. And we here state, that we do not claim the exclusive use of any of the parts (taken as parts) of the machinery described and shown, but only in so far as the same is used in combination for the purposes of our invention, which we declare to be, and we claim the sole use of the combination of parts hereinbefore described, forming apparatus or machinery for expressing liquid or moisture from substances." And that, I say, was very wisely and properly done, because there had been a great number of inventions leading up to the plaintiff's invention; but the plaintiff's invention ultimately appeared to me—and that has been acquiesced in by the defendant—a really useful and valuable invention; inasmuch as, though there had been a straining or filtering process by forcing liquid into bags containing the matter to be filtered—although there had been receptacles in which those bags had been placed, one upon another, covered with wicker baskets, or wicker work upon them—although pressure had, in other ways, been resorted to, where the whole of the matter to be pressed was confined, but not with any system of chambers or cells, like those described by the plaintiff,—the plaintiff's invention consisted, as it seemed to me, in his very ingeniously availing himself of all those arrangements that had gone before him, but superadding that which enabled him to form a compound filter that was capable of being augmented to any extent, without any augmentation of the strength of the machine, beyond the raising the retaining walls of the whole set of chambers wherein the pressure to be exercised in the machine was to be carried on. That invention was exceedingly ingenious, as it seemed to me, from this circumstance, that you placed the filtering bags into which the water was to be forced, employed for the means of completing the filtering process, in layers, one over another, but separated by slabs, as he calls them, or boards, which need not be of any great thickness; because the slabs or boards, reacting one upon the other, enable you to throw all your strength into the retaining walls or set of boards which were

fastened round it, and which set of boards, so fastened round, were retained and strengthened with strong pieces of iron, and made as firm as possible, for the purpose of containing all that was within the apparatus that was to be operated upon. There were minor details in the operations, but the main feature, as I have said before, was the devising an apparatus by which this could be multiplied in an unlimited manner by slightly raising or augmenting the height of the retaining walls, and without occasioning any additional pressure by the multiplication of the bags which were to be operated upon within the walls; and the further and minor details were these—that you allowed space for the air to escape on the one hand, while this pressure was going forward at the upper part of the slab, and for the water, on the other hand, to escape by a certain set of grooves, which were made for the purpose of allowing the superfluous water to run away, and the drainage to take place which is necessary in all operations of this description; it is a part of the process. He had been led up to this, undoubtedly, by a number of other inventions, to which he put the finishing stroke by this ingenious invention of his, combining these two points—facility of multiplication, and the distribution of the pressure in such a way as that the ultimate pressure, whatever number of slabs or chambers you employed, would in the result be the same upon the walls of the containing apparatus.

The defendant has now made an apparatus of this description; He has taken a cylinder, and he places on either side of the cylinder an annular chamber, and he places in the interior of the cylinder a large double division, which he calls a core—a core split into two parts. These chambers are formed of frames of wire work, and the wire work rests on the one side upon the outside cylinder, and on the other side upon the intermediate core; and that is the case with each chamber, that it has this wire work on each side of the core. The core is formed in this manner:—there is an angle iron, as it is called, between these two divisions, and by a strong screw it is so kept in its place whilst the operation of pressure is being performed, that the pressure can go on to any extent whatever, and the two frames resting upon the core, whether you operate upon the one frame singly or on the other frame (if they operated on the two frames together, they would be then jointly pressing on the core), the pressure would take place, and the action and reaction to a certain extent would take place; but the frames are made in themselves so strong that it was admitted—at least, the case was brought to that when I proposed an experiment being made on the machine—that the frames were strong enough in themselves to resist such pressure as might be brought to bear on one of those two chambers, in the event of the other chamber being empty. Of course, a block would be put on when the other side was empty; but it was conceded, on the one side, that the frame would be strong enough to resist the pressure, and, on the other hand, if the frame were not there, the centre core would be moved and shaken from its place, and the operation could not take place at all. Then, in order to take out the bags and the dried material which is in the bags, you, by an ingenious arrangement, relax the screw, tilt up the central core in such a fashion as will bring it together, and on either side of this cylinder the bags can be extracted.

Now, it was said that this was an invention derived from Durnerin. Upon that part of the case, notwithstanding the affidavits of able gentlemen, engineers, and others, on the defendant's side, I do not believe that the mental process was a mental process which followed the path, as Mr. Aston pointed out in his argument, of Durnerin. But my reason for thinking that the defendant was not so led, and that which made me hesitate most in the whole case, was the defendant's own patent, in which he plainly describes his mode of procedure. The first part of his patent appears to me to be the plaintiff's machine, and nothing else, and if I had only to deal with that, I should have known how to deal with it. The first part of the defendant's patent is this—"This invention has for its object improvements in filtering apparatus. For these purposes filtering bags or cloths are placed in frames, each bag or cloth being by preference between two sheets of wire cloth, which may be fixed in frames or made suitable to fit into the

frames. Two or more of such frames, with their filter bags or cloths, are used in each apparatus in such manner that one of the edges of one frame comes next, and abuts against the edge of the other frame; this, however, is not essential, as there may be ribs or projections on the interior of the apparatus, within which two or more frames are used, so that the edges of the neighbouring frames may be prevented coming against each other by the ribs or projections. The frames, and the wire-work used with them, may be flat, or they may be of a bent or curved form. The form of the apparatus used to receive the frames, with their filtering cloths, may be varied. An apparatus of a circular rectangular section is preferred." Now, really, if you had these filtering bags and their several chambers all standing one upon another, with a certain rectangular form, it would be simply the process which the plaintiff has invented; he confining his filtering bags by putting this wire instead of putting the plaintiff's slabs, and putting them one upon another, trusting to the action and reaction of those two things as they went on, and so composing a sort of filtering pile like the plaintiff's. But now as regards this other matter, although I think he was led up to his invention by the advantage he had in knowing what the plaintiff had done before, yet, after giving every possible consideration to the case, which one so nearly bordering on evasion would permit, I am led to the conclusion that he has availed himself no more of the plaintiff's proceedings than the plaintiff has availed himself of what went before him. The plaintiff was entitled, and had a right, to combine the various ideas that had been thrown out by other persons as leading him on. Of course, if they had obtained patents he could not have taken the identical things which they did; but he took advantage rather of the various ideas and the general notions which had been suggested, for instance, by such a scheme as Billiter's, which is not adopted by the plaintiff at all. The wicker work would not have answered his purpose; he could not have taken that wicker work or the like, but that idea led him up to the invention in some measure which he has completed by subsequent invention. The defendant has seen the advantage, no doubt, of having a strong confining wall; that is the only thing he would see in Durnerin's, in the cylindrical form. He sees the advantage of that, and he sees an advantage, of course, in having smaller chambers in which the operation could be carried on, as admitting of being more easily dealt with. But when you come to the two main features of his patent, those, I confess, I do not find in the plaintiff's. Those two main features, I think, are the system of mutual support by the action and reaction of the two chambers, or the three or four, as the case may be, which are immediately in contact, one with the other—their mutual action and reaction; and, on the other hand, the facility afforded by the plaintiff's form and scheme for multiplying that arrangement to any extent. Now, I apprehend that this scheme of the defendant's will not admit of multiplication; at all events, he has not used multiplication, nor will the machine, in this cylindrical form, admit of any such multiplication as that. And, certainly, it would be going a great deal too far to say that there is action and reaction here, because there is pressure on the central core on each side. So far, no doubt, there is that certain degree of action and reaction. But, on the other hand, you have that which is by no means an essential part of the defendant's apparatus, in no way, in fact, forming an advantage in his scheme; because his frame is sufficiently strong in itself without any sort of reaction of this kind taking place, to keep the cylinder in its place, or to keep the core, as it is called, in its place. He does not want that. He has, in fact, two chambers, each pressing on a solid core, and this solid core is the contrivance which he adopts for relieving these two chambers, so pressed from their position; and it appears to me to be a contrivance so entirely different in the two respects I have mentioned—namely, in his not relying upon the pressure, and action and reaction, of each part upon another, and as combined with that, the faculty of multiplying to any definite extent the chambers which he intends to introduce into the machine,—that although he has been largely indebted, I think, to the ideas thrown out by the plaintiff with reference to the

machine which he has adopted, I cannot say any more in his case than in the case of Curtis v. Platt, where Mr. Platt was, in the first instance, undoubtedly very considerably indebted to the plaintiff in that case for one mode of applying a well-known arrangement; yet, it was open to Mr. Platt to say, "I have got another and a better mode; now you have told me your mode, I can see that." It led to the suggestion of another and a better mode of doing it; so it seems to me here that the defendant has been led to another mode of effecting his object, I cannot say a better one, because I do not know whether it is or not. In some respects it is an inferior one, in not admitting the multiplication, which the plaintiff's does. He has been led from that to adopt a machine which he has been led up to by the idea being first thrown out by the plaintiff, but which he has not introduced into his machine. I think, therefore, he has really and substantially, and not colourably—for that is the whole point of the case—avoided a distinct interference with the plaintiff's patent; and I think, therefore, I must refuse the motion, and, having regard to the usual course in these cases, I must refuse it with costs.

The solicitors for the plaintiffs were Messrs. Pyke and Irving; for the defendant, Messrs. Harbin and Smith.

Provisional Protections Granted.

[*Cases in which a Full Specification has been deposited.*]

1865.

769. Solomon Sally Gray, of Boston, impd. machinery for manufacturing paper and cloth lined paper collars for gentlemen and ladies.—*March 20th.*

786. John Henry Johnson, of Lincoln's-inn-fields, impts. in the manufacture of looking glasses or mirrors, and in apparatus employed therein,—a communication.—*March 21st.*

819. Robert Wilson Morrell, of Bradford, Yorkshire, impts. in machinery for sewing and stitching.—*March 23rd.*

912. Henri Adrien Bonneville, of Paris, impts. in the manufacture of iron rods and bars of different forms, and in the apparatus relating thereto,—a communication.—*March 31st.*

Cases in which a Provisional Specification has been deposited.

1864.

2870. Joseph Sheppard, of West Brompton, impd. arrangements for the protection of watches, purses, and other valuables worn on the person.—*November 17th.*

3048. Carl Alexander Martius, of Warrington, impts. in the application of photography to the ceramic arts or to glass,—a communication.—*December 6th.*

3133. William Brookes, of Chancery-lane, impts. in steam blowers,—a communication.—*December 17th.*

3177. Robert Wilson, of Manchester, impts. applicable to call and other bells,—partly a communication.

3179. John Fothergill and John Henry Fothergill, of the City-road, impts. in machinery or apparatus employed in propulsion of vessels.

The above bear date December 22nd.

3255. Paul André Roger, of Paris, impts. in smoke-consuming furnaces.—*December 31st.*

1865.

6. Montague Richard Leverson, of Bishopsgate-street Within, impd. method of treating apatite and other mineral phosphates,—a communication.—*January 2nd.*

18. George Hodgson and James Pitt,

both of Cleckheaton, impts. in drilling apparatus for hand or steam power, adaptable also as a vice for lifting purposes.—*January 3rd.*

161. Emmanuel Dennis Farcot, of Neuilly, near Paris, impts. in oars, and in the modes of actuating them. —*January 19th.*

288. Alexander Southwood Stocker, of Wolverhampton, impts. appertaining to reflectors.—*February 2nd.*

314. William Clark, of Chancery-lane, impd. combustion pump,—a communication.—*February 4th.*

334. Henry Masters, of Bristol, impts. in connection with sewing and other machines.

342. Romain de Bray, of Rennes, France, impd. reflecting apparatus for street and other lamps.

343. John Butler Watters, of Maidstone, impts. in machinery or apparatus for brushing the hair.

The above bear date February 7th.

386. John Porter and James Porter, of Boston, Lincolnshire, impts. in the permanent way of railways.—*February 11th.*

409. William Edward Newton, of Chancery-lane, impts. in the manufacture of sheet iron,—a communication.—*February 13th.*

421. Johann von der Poppenburg, of Birmingham, impts. in breech-loading fire-arms, and in cartridges for breech-loading fire-arms.

422. George Homfray, of Halesowen, Worcestershire, impts. in the mode of making or forming the links of iron or steel chains, chain cables, shackles, couplings, or parts of the same; and for machinery to be used therein.

423. Robert Pasco Barrett, of Commercial-road East, impd. combined garment.

424. James Purdey, of Oxford-street, impts. in breech-loading fire-arms.

425. Benjamin Thompson, of Birmingham, impts. in fire-arms,—a communication.

426. Benjamin Thompson, of Birmingham, impts. in cartridges,—a communication.

The above bear date February 14th.

427. Samuel Richards Freeman, of Manchester, and Abraham Grundy, of Rusholme, near Manchester, impd. blowing apparatus.

428. William Ashton Hackett, of Cork, impt. in fish-hooks.

429. William Collinson Ridings, sen., of Middleton, Lancashire, impd. protector for the needles and cards used in jacquard machines.

430. Alfred Vincent Newton, of Chancery-lane, impts. in sewing machines, —a communication.

431. William Henry Brown, of Sheffield, impts. in cast-steel or other metal chains for cables, and for other purposes, and in machinery or apparatus for manufacturing the same.

432. Michael Lane, of Paddington, impts. in apparatus for working and controlling railway switches, points, and signals.

433. Charles Lungley, of Deptford, impts. in ventilating blinds or screens, and in means of ventilating ships and vessels.

434. Denison Chauncey Pierce, of New York, impts. in railway rails.

435. Francis Joseph Emery, of Cobridge, Staffordshire, impts. in ornamenting china and earthenware, and in preparing materials to be employed therefor.

436. George Tyrrill Humphris, of Walton-on-Thames, impts. in pumps, and apparatus for working the same.

437. Robert Henry Emerson, of Dublin, impd. invalid or syphon drinking cup.

438. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in the construction of armour-plated ships,—a communication.

The above bear date February 15th.

441. William Kirrage, of Gardener's-road, Victoria Park, impt. in the manufacture of artificial stone for building and other purposes.

442. Richard Archibald Brooman, of Fleet-street, impts. in the manufacture of boots, shoes, and other like coverings for the feet,—a communication.

443. Edward Brown Wilson, of Glasgow, impts. in furnaces.

444. Henry John Pickard, of Keyworth, Nottinghamshire, impd. ma-

chine for clearing, sweeping, and removing the refuse from highways, streets, and roads, or ways; applicable also for removing the leaves of cut grass and other refuse from lawns and other grass lands and walks.

445. Henry Clifton Cleaver and Joseph Cleaver, of Nottingham, a fog or other signal, for the prevention of collisions at sea, or on rivers or canals, or on land.

446. Charles Octavius Staunton, of Paulton-square, Chelsea, impts. in apparatus for lifting and tilting casks containing liquids.

447. William Edward Newton, of Chancery-lane, impts. in apparatus for distilling petroleum and other volatile liquids, and for making gas, —a communication.

448. John Fulleck Hearsey, of Park-place, Brompton, impd. apparatus for measuring the specific gravity of liquids,—a communication.

449. François Alexandre Laurent, John Casthelaz, and Nicolas Basset, all of Paris, impts. in the manufacture of oxalic acid.

450. Joseph Thompson, of Manor House, Camberwell-road, impts. in safes.

451. Richard Smith, of Cumming-street, Pentonville, impts. in treating sewage, and in arranging apparatus in sewers and culverts to facilitate the ventilation of such structures.

The above bear date February 16th.

452. Richard Hill and Robert Tushingham, of Garston, Lancashire, impd. preparation or treatment of clay for the manufacture of bricks.

453. William Edward Gedge, of Wellington-street, impd. method and machinery for the manufacture of various articles in pottery, earthenware, or porcelain by mechanical process,—a communication.

454. Coleman Defries, of Houndsditch, impd. means of securing the safety of railway passengers.

455. John Brown, of Sheffield, impts. in armour plates for vessels of war, and for other similar purposes.

456. John Osborne Christian, of Manchester, and John Charlton and Henry Charlton, of Strangeways, impts. in the manufacture of magnesium and its compounds.

457. William Clark, of Chancery-lane, impts. in shifting wrenches,—a communication.

458. James Bryce Brown, of Cannon-street, City, impts. in lawn mowing machines.

459. James Fergusson, of Langham-place, impts. in iron safes and strong rooms.

460. Charles Frederick Claus, of Fearnhead, near Warrington, impts. in obtaining sulphates and carbonates of potash and soda.

The above bear date February 17th.

461. Thomas Philip Tregaskis, of Perran-ar-Worthal, Cornwall, impd. use of magnets in over-balancing weights.

462. Pierre Eugene Bidaux, of Paris, impts. in the application to clocks and alarms of a circular escapement in place of the ordinary balance wheel,—a communication.

463. Emile Carchon, of Paris, impts. in dying the herbs and straw used in the manufacture of straw hats and artificial flowers or other fancy articles.

464. John James Chidley, of Glaskin-street, Hackney, impd. method of stopping bottles.

465. Christopher Brakell, William Hoehl, and William Günther, of Oldham, impd. composition as a substitute for leather or other similar materials.

466. Thomas Ogden, of Cliff Mound, Higher Broughton, near Manchester, impts. in mechanism or apparatus for lubricating the cylinders of "slashing" and "tapeing" machines; such machinery being employed in the sizing of cotton and other yarns.

467. Richard Archibald Brooman, of Fleet-street, impts. in filters,—a communication.

468. James Grafton Jones, of Blaina Iron Works, near Newport, impts. in beam engines.

469. James Graham, of Warrington, impts. in treating products obtained when coating iron with zinc.

470. William Robinson, of Watling-street. City, impts. in the manufacture of iron and in articles made thereof.

471. Charles Désiré Barge and Alexandre Hermant, of Paris, impts. in waterproof and other coats and capes.
472. Leicester William Glen Rowe, of Henrietta-street, Brunswick-square, and Adolphe Baab, of Hampstead-road, impd. indicating apparatus for the protection of railway passengers, buildings, rooms, safes, and other objects.
473. John Gay Newton Alleyne, of Alfreton, Derbyshire, impts. in puddling furnaces, and in apparatus connected therewith.

The above bear date February 18th.

474. George Henry Hibbert Ware, of Tunbridge Wells, impd. apparatus for shifting points on railways from an engine or train in motion.
475. Henry Percy, of Bawtry, Yorkshire, impts. in sewing mechines.
476. Andrew Sharp, of Glasgow, impts. in the construction of cabinet, sofa, and chair bedsteads.
478. Joseph Cliff, of Wortley, near Leeds, impt. in the utilization of the waste gases of blast furnaces.
479. John Davidson Nichol, of Edinburgh, impts. in apparatus for folding envelopes.

The above bear date February 20th.

480. Charles William Homer, of Dukinfield, impts. in machinery for making and pressing bricks.
481. Robert Willson, of Alloa, N.B., impts. in mashing machines, and in apparatus connected therewith.
482. William Hitchin, of Birmingham, impts. in sash fasteners; and which said fasteners are also applicable to other useful purposes.
483. John Henry Johnson, of Lincoln's-inn-fields, impts. in machinery or apparatus for kneading or working dough,—a communication.
484. Charles Baulch, of Bristol, impts. in machinery for sewing or uniting leather and other hard substances; particularly applicable to the manufacture of boots and shoes.
485. John Russell Swan, of Edinburgh, impts. in steam-engines.
486. William Edward Newton, of Chancery-lane, impts. in apparatus for extracting liquid from solid substances,—a communication.

The above bear date February 21st.

487. Eugenio Jesurum, of Gresham-street, City, impts. in machinery for stopping railway trains,—a communication.
488. Charles Vincent Walker, of Fernside, Redhill, and Alfred Owen Walker, of Florence-road, New Cross, impts. in the construction of electro-magnetic apparatus for railway signalling and other purposes.
489. John Keighley and Richard Shephard, both of Laister Dyke, near Bradford, impts. in circular box looms.
490. James Mallison, of Halliwell, near Bolton, impd. method of treating yarns or threads previously to the processes of dyeing and dressing.
491. Isaac Pariente, of Manchester, impts. in scarfs, and in the manufacture of the same,—a communication.
492. Richard Archibald Brooman, of Fleet-street, impd. mercuro-hydraulic motor,—a communication.
493. Jasper Hulley, of Macclesfield, impts. boilers for heating water and delivering it at an equal temperature to any number of flow pipes, and also for the generation of steam.
494. John Dodgeon, of Burnley, John Gaukroger, of Hebden-bridge, Yorkshire, and William Shackleton, of Todmorden, impts. in looms for weaving.
495. Herbert Panmure Ribton, of Kingstown, Dublin, impd. fastener for envelopes.
496. William Edward Newton, of Chancery-lane, impd. balanced slide valve,—a communication.
497. Thomas George Webb, of Manchester, impts. in the manufacture of ornamented articles of glass.
498. John Carter, of Prince of Wales's-road, Haverstock-hill, impts. in apparatus for ventilating hats.
499. George Nathaniel Shore, of Lyme Regis, impts. in iron safes and strong rooms.
500. James Nicholas, of Aspull, near Wigan, impts. in the process and apparatus for producing oil and coke from coal and slack.
501. Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, impts. in

obtaining motive power from aeriform fluids and from liquids.

502. David Barr, of Birmingham, impts. in machinery for dressing fruit.

The above bear date February 22nd.

503. Aaron Barker, of Millgate, near Rochdale, impts. in looms for weaving.

504. Godfrey Sinclair, of Edinburgh, impts. in signalling between passengers and guard or driver in railway trains.

505. William Westbury and Thomas Wathen, of Birmingham, impd. means for holding attaching, or suspending fancy articles as exposed in bazaars, show rooms, or shop windows for sale; as well as the providing of means for portably fitting or holding the price ticket to such articles; a modification of which arrangement is also applicable for holding and filing papers or other purposes.

506. William Henry Aubin, of Wolverhampton, impts. in breech-loading fire-arms.

507. Samuel Whitfield, of Birmingham, impts. in locks or fastenings for safes or strong boxes.

508. Walter Sandel Mappin, of Birmingham, impts. in the manufacture of safes or strong boxes.

509. George Haseltine, of Southampton-buildings, impts. in ships of war, partly applicable to ships designed for the merchant service,—a communication.

511. Samuel Saville, of Manchester, impts. in separating wool from refuse, mixed fabrics, and materials.

512. William Edward Newton, of Chancery-lane, impd. mode of preparing fertilizing compounds or artificial manures,—a communication.

513. William Rowe, of Plymouth, impts. in the construction of buffers for railway carriages.

514. Henry Kindon Taylor, of Bath, impts. in the means and apparatus employed for protecting bullion, jewellery, or other valuable property contained in safes, from being stolen or damaged by fire.

515. Adolph Meyer and Moritz Meyer, of Liverpool, impts. in preparing explosive compounds,—a communication.

The above bear date February 23rd.

516. Joseph Jacob and Rudolph Pilzinger, of Dudley, Worcestershire, impts. in the method of and apparatus for generating heat.

517. William Edward Gedge, of Wellington-street, impd. apparatus for shearing and burling all sorts of woven fabrics,—a communication.

518. Charles William Lancaster, of New Bond-street, impt. in cartridges for breech-loading guns.

519. Henry Everard Clifton, Saul Myers, and Abraham Hoffnung, all of Liverpool, impts. in cap carriers for fire-arms.

520. John Kennedy Donald, of Glasgow, impts. in the permanent way and rolling stock of railways.

521. William Oram, of Salford, impts. in hydraulic pumps in connection with engines of motive power.

522. James Howard, of Bedford, impts. in steam engines applicable to ploughing and other agricultural purposes.

523. Samuel William Worssam, of King's-road, Chelsea, impts. in machinery for sawing wood.

525. Charles James Rowe, of Maldon-road, Haverstock-hill, impts. in portable invalid or bed tables.

526. James Hundy, of Birmingham, impd. instrument or apparatus for raising weights for moving heavy bodies and for other like purposes.

527. William Winter, of Leeds, impts. in sewing machines.

528. James Nicholas, of Aspull, near Wigan, impts. in converting coal oil into gas, suitable for use as an illuminator.

529. James Badcock, of Westmoreland-buildings, Aldersgate-street, impts. in crinoline skirts, and in fastenings for the steels or hoops of the same.

530. George Score, of Clarendon-gardens, Maida-hill, communicating with the guard of a railway train by means of a folding foot board.

531. Edmond Paul Henri Gondouin, of Paris, impts. in cotton gins,—a communication.

The above bear date February 24th.

532. Thomas Routledge, of Sunderland, and Thomas Richardson, of Newcastle-upon-Tyne, impts. in the treatment and utilization of certain products obtained in the manufacture of paper or of paper stock.
533. James Hyndford Rawlins and Joseph Chappell, both of Hope Paper Mills, near Wrexham, impts. in machinery or apparatus used in the manufacture of paper.
534. Frederic Claudet, of Coleman-street, City, impts. in the preparation of certain iron ores or residues for use in the blast furnace.
535. James Starley, of Coventry, impts. in sewing machines.
536. Thomas Dronsfield, Thomas Edwin Jones, and John Ashton, of Oldham, impts. in mechanism or apparatus for "blocking," rolling, and measuring calico, linen, flannel, or other woven fabrics.
539. William Calvert, of Leeds, impts. in signalling on railways.
541. Ralph Smyth, of Hampton Court, impts. in organs and harmoniums.

The above bear date February 25th.

543. Walter Henry Tucker, of Southampton-street, impts. in fire and thief proof safes, chests, and strong room doors.
544. Henry Henson Henson, of Parliament-street, impts. in railway chairs, fastenings, and sleepers.
545. Ferdinand Dancart, of Paris, impts. in apparatus or bell alarms to facilitate the communication between passengers and guards of railway trains, which said apparatus is equally applicable to apartments and other similar purposes.
546. George Kennedy Geyelin, of South Hackney, impt. in air-tight jars for preserving eggs and fruits, and such like articles of food.
547. Comyn Ching, of Little St. Andrew-street, St. Martin's-lane, impd. fluid valve.
548. Michael Barker Nairn, of Kirkcaldy, impts. in the manufacture or treatment of floorcloths.
549. William Sim, of Glasgow, impd. method of extracting gases from mineral oils, and in employing the same for illuminating and heat producing purposes, and in the machinery or apparatus connected therewith.
551. Robert Barclay, of Kilmarnock, impts. in sewing machines.
552. Richard Archibald Brooman, of Fleet-street, combined key and weapon of defence, —a communication.
553. John Blackie, jun., of North Woolwich, impts. in signalling apparatus especially applicable to signalling on board ship,—a communication.
554. George Haseltine, of Southampton-buildings, impts. in the manufacture of mirrors,—a communication.
555. George Thomas Ellwick, of Phœnix-place, Ratcliff-cross, impts. in machinery or apparatus for baking biscuits.

The above bear date February 27th.

557. Mark Mason, of Manchester, impts. in apparatus for cutting paper, pasteboard, and similar substances.
559. John Matthias Hart, of Cheapside, impts. in the construction of doors or other covers of safes or depositories, and in parts connected therewith, for the purpose of obtaining increased security.
560. Arthur Davey, of Sheffield, impts. in making solid iron scales with bolsters for all kinds of spring knives.
561. William Clark, of Chancery-lane, impts. in the means of decorticating grain and other seeds, and in apparatus for the same,—a communication.
562. William Bell Dalston, of Pittsburgh, Pennsylvania, U.S.A., impd. atmospheric pressure lamp for the burning of benzole, paraffin, naphtha, or other volatile oils; which lamp may be used for all the purposes for which lamps are usually required, either for lighting, cooking, heating, or other purposes,—partly a communication.
563. David Chalmers, of Glasgow, impts. in the manufacture of textile fabrics, and in the machinery or apparatus employed therefor.
564. John Fordred, of Blackheath, impts. in treating certain hydro-carbon oils, and in vessels for containing the same.
565. George Weigmann, of Moorgate-street, City, impts. in dies for cutting screws,—a communication.

566. James Hartshorn and William Redgate, of Nottingham, impts. in manufacturing lace in twist-lace machines.

567. Sydney Whiting, of Maida-hill West, impts. in shop and other counters and surfaces on which money is placed in passing it from one person to another.

568. Thomas Slocombe Hall, of Truro, Cornwall, impts. in gas burners.

The above bear date February 28th.

569. Jean Baptiste Toussaint, of Paris, impts. in gaiters, spatter-dashes, and other similar articles.

570. Samuel Whitfield, of Birmingham, impts. in locks and bolts for fastening doors, and door bars and drawers.

571. James Young, of Manchester, impts. in distilling bituminous substances, and in apparatus employed therein.

572. George Harman Barth, of York-road, St. Pancras, impts. in condensation and refrigeration of vapours and fluids.

573. William Holiday, of Bradford, Yorkshire, impts. in presses for blocking the tyres of railway and other wheels.

574. Carl Johan Falkman, of St. Petersburgh, impts. in apparatus for distilling, purifying, and storing spirituous liquors.

575. Moses Bayliss, of Wolverhampton, impd. machine for pointing or drawing down railway spikes; and which said improved machine is also applicable for forming or drawing down the shanks of ordinary spikes, and other articles of irregular shape.

576. Nicholas Henwood, of Tideford St. German's, Cornwall, impts. in reaping machinery.

577. John Dodd, of Oldham, impts. in mules for spinning and doubling.

578. William Edward Kochs, of Cannon-row, Westminster, impts. in the construction of beams or supports applicable to the building of bridges, viaducts, roofs, arches, and ships; and in instruments to be used therein.

579. Augustine Thomas Godfrey, of Offord-road, Barnsbury, impts. in musical instruments, in the nature of organs, in which reeds are employed.

The above bear date March 1st.

580. Thomas Horton, of Prior's Lee Hall, Salop, and David Simpson Price, of Great George-street, impts. in the treatment of certain products obtained in the smelting of iron.

581. James Park, of Bury, Lancashire, impts. in machinery employed in the manufacture of paper; part of which is applicable to drying cylinders for other purposes.

582. John Muir Hetherington, of Manchester, impts. in making the joints of steam generators and parts connected therewith.

583. Samuel Brooks, of the Union Iron Works, West Gorton, near Manchester, impts. in and applicable to looms for weaving.

584. Samuel Hopkinson and Edwin Hopkinson, both of Bradford, impts. in smoke-consuming apparatus.

586. John Kirkland, of Liverpool, impd. arrangement of and addition to certain parts of omnibuses and other vehicles, to indicate the number of passengers carried.

587. David Hartley, of Oldham, Lancashire, improved "core" to be employed in the casting of metallic pipes or tubes.

589. Peter Rothwell, of Denton, Lancashire, impts. in arrangements or apparatus to be applied to vehicles drawn by horses, to restrain and prevent them from running away.

590. William Edward Newton, of Chancery-lane, impd. process and apparatus for impregnating wood with chemical solutions,—a communication.

591. Charles Rahn, of Brook-street, Grosvenor-square, impd. instrument for concentrating light, applicable to dental, surgical, and other operations.

592. Robert Johnson, of Waterloo-place, Pall Mall, impts. in constructing strained wire fences.

593. John Macmillan Dunlop, of Manchester, impts. in carding engines.

594. William Clark, of Chancery-lane, impts. in the manufacture of buttons, —a communication.

595. Charles Lewis Roberts of St. John-street, Clerkenwell, impt. in cigars.

The above bear date March 2nd.

596. William Renwick Bowditch, of Wakefield, Yorkshire, impt. in car-

buretting gas, also in the preparation of hydro-carbons for carburetting gas, and impd. methods of treating alkali which has been used to purify coal oils, shale oils, petroleum, and other mineral oils.

597. David Manwell and James Manwell, of Glasgow, impts. in driving piles, and in apparatus therefor.

599. Richard Archibald Brooman, of Fleet-street, impts. in refining sugar and in apparatus employed therein,—a communication.

The above bear date March 3rd.

602. Luke Thomas, of Dawson-place, Bayswater, impts. in side propellers for ocean and river vessels.

603. Henry Adrien Bonneville, of Paris, impts. in drying apparatus,—a communication.

606. John Henry Johnson, of Lincoln's-inn-fields, impts. in stopping bottles,—a communication.

607. John Henry Johnson, of Lincoln's-inn-fields, impts. in steam generators,—a communication.

608. Henry Taylor, of Nottingham, impts. in the manufacture of lace or other fabrics made on bobbin net or twist lace machines, and in the machinery or apparatus employed therein.

609. Daniel Morris, of Haslingden, Joseph Morris, of Ramsbottom, and James Morris, of Haslingden, all in Lancashire, impts. in apparatus for coupling and uncoupling railway waggons or carriages.

610. Louis Le Chevalier Cottam, of Winsley-street, Middlesex, impt. in fitting sliding partitions in stables and other buildings.

611. Richard Archibald Brooman, of Fleet-street, impts. in machinery for obtaining motive power from ammoniacal gas,—a communication.

612. William Clulow, of Sheffield, impts. in the manufacture of sheep shears.

613. Edward Humphrys, of Deptford, impts. in combining marine steam boilers.

614. Joseph Whitley, of Leeds, impts. in casting steel railway-wheel tyres.

615. William Edward Newton, of Chancery-lane, impt. in putting up tobacco for smoking, and in the implements or pipes for smoking the same, and in making tobacco-paper,—a communication.

616. Thomas Turton, of Sheffield, impd. machine for shaping file or other blanks by means of dies fitted into vibrating jaws.

617. Abraham Akeroyd, of Bradford, Yorkshire, impd. process and apparatus for dyeing and preparing cotton, worsted, and silk warps.

618. Edwin Pettitt, of Birmingham, a method of, or process for, producing a new kind of photographic pictures.

The above bear date March 4th.

619. Cromwell Fleetwood Varley, of Beckenham, Kent, impd. apparatus for the protection of houses and property from burglars; parts of the invention being applicable for other purposes.

621. Richard Archibald Brooman, of Fleet-street, impts. in pumps,—a communication.

621. Samuel Phillips and Joseph Groves, of Birmingham, impts. in safes.

622. Samuel Smith and William Smith, of Keighley, Yorkshire, impts. in machinery or apparatus for combing wool and other fibrous substances.

624. Francis Cruickshank, of Edinburgh, impts. in coatings for the prevention of the fouling to which iron and other ships and structures are ordinarily liable in sea water.

625. Thomas Craig and David Carlaw, of Glasgow, impts. in numbering machines.

626. William John Oliver, of Manchester, impd. means of securing and protecting the india-rubber rings of buffer springs of railway carriages; which invention is also applicable to air-pump and valve seatings and lids faced with india-rubber.

627. Andrew Potts, of Cappagh, Ireland, impts. in machinery for scutching and refining flax and other vegetable substances.

628. William Riddle, of Guildford-road, South Lambeth, impts. in hooping or binding bales.

629. Thomas Nicholson, of Gateshead, impd. process of, and apparatus for, making caustic liquor or caustic lees.

630. George Nimmo, of Jersey City, impts. in the manufacture of crucibles and pots in which metals or other substances may be melted.
631. William Clark, of Chancery-lane, impts. in preparing or treating hides for tanning,—a communication.

The above bear date March 6th.

632. William Bünger, of Southampton-buildings, impd. apparatus and means for ascertaining the quality and condition of grain and seed,—a communication.
633. Edward William Young, of Blandford-place, Middlesex, impts. in the construction of bridges.
634. Richard Archibald Brooman, of Fleet-street, impts. in tubular boilers,—a communication.
635. John Heselgrave Wilson, of Huddersfield, impd. method of, and means or apparatus for, measuring the human body.
636. Loftus Perkins, of Francis-street, Gray's-inn-road, impts. in apparatus for heating and cooling atmospheric air and other aeriform bodies, and for heating ovens, and for heating and ventilating buildings.
637. Alexandre Eugene Adolphe Aubert and Gustave Eugene Michel Gerard, of Paris, impts. in the manufacture of shoes and other coverings for the feet.
638. William Clark, of Chancery-lane, impts. in cork cutting machinery,—a communication.

The above bear date March 7th.

639. William Clark, of Chancery-lane, impts. in shoes for horses and other animals,—a communication.
640. Henry William Wimshurst, of Willmott-road, Dalston, impts. in the construction of joints for boxes, drawers, and other like articles, and for planks and timbers, and in machinery to be used in the preparation of such joints.
641. James Dodge, of Manchester, impts. in steam hammers applicable to the manufacture of files, to welding flyers of cotton machinery, and to other purposes.
644. Joseph Wadsworth, of Marple, Cheshire, and James Wadsworth, of Heaton Norris, near Stockport, in machinery or apparatus for impts. cutting and shaping metals, making nails, rivets, and similar articles.
645. Arthur Charles Henderson, of Charing-cross, impd. method of preserving meat,—a communication.
646. George Ireland, of Handsworth, impts. in stoppers for closing bottles and for other like purposes.
647. Francis Wise, of Chandos-Chambers, Adelphi, impd. packing for piston rods and other rods,—a communication.
648. John Shanks, of Barrhead, N.B., impts. in water-closet apparatus.
649. Morgan Morgans, of Brendon-hills, Somersetshire, impts. in converting cast iron or pig iron into wrought iron or steel, and in machinery employed therein.
650. Richard Howson, of Preston, impts. in stoves for heating air supplied to blast furnaces.
651. William Clark, of Chancery-lane, impts. in motive-power engines,—a communication.
652. Frederick William Turner, of Linslade, Bucks, impts. in machinery for grinding corn and other substances, and in horse gear or apparatus for driving the same, which horse gear is also applicable for driving other machinery.
653. Arthur Edwin Taylor, of Barnes, Surrey, impts. in iron safes.
654. William Clay, of Liverpool, impd. manufacture of iron forgings.

The above bear date March 8th.

655. William Tighe Hamilton, of Upper Rath Mines, Dublin, impd. method of, and apparatus for, facilitating the proper action of the hands of players upon the piano, organ, harmonium, or other liked keyed instruments.
656. Benoni Collins, of Manchester, impts. in cutting sheets of India-rubber and like materials into strips or threads, and in machinery or apparatus for the purpose.
657. Robert Mushet, of Cheltenham, impts. in the manufacture of steel and homogeneous iron.
658. Emile Carchon, of Paris, impd. system of closing spatter dashes; applicable also to boxes, porte-monnaies, and other similar articles.

659. William Clark, of Chancery-lane, impts. in revolving fire-arms,—a communication.
660. Joseph Thomas Harris, of Bristol, impd. iron doors, especially adapted for use in ordinary buildings.
661. William Henry James, of the Old Kent-road, impts. in carriage ways, and in carriages for the same.
662. Rowland George Fisher, of Great George-street, Westminster, impts. in rolls for connecting sheets of zinc and other metals employed for covering roofs and other enclosures.
663. William John Dorning, of Manchester, impts. in the method of securing the extremities of bands or hoops used in packing bales, and in the means employed for such purpose.—a communication.
664. William Henry Hudson, of Hereford, impd. burglary alarum.
665. William Daniel Allen, of Sheffield, impts. in the manufacture of railway wheel tyres, and in the implements or tools employed in such manufacture.
666. Joseph Cliff, of Wortley, near Leeds, impt. in the construction of hot air stoves for blast furnaces.
667. Edmund Leahy, of Cardington-street, Middlesex, impts. in the strengthening and ornamenting of collapsible or soft metal tubes.
668. George Frederick Ansell, of Bernard-street, Russell-square, impd. mode of, and apparatus for, ascertaining and indicating the presence of explosive gases.
669. Victor Delperdange, of Brussels, impd. method of connecting together tubes or pipes used for conveying gas and water, and for other purposes.

The above bear date March 9th.

670. Joseph Freeman, Edward Grace Freeman, and Charles Henry Freeman, of the White Lead Works, Battersea, impts. in the preparation of turpentines and varnishes.
672. William Smith, of Kennington, impts. in the construction of fastenings or bolts for window sashes and other purposes.
673. Evan Leigh, of Manchester, impts. in cotton gins.
674. John Lyon Field, of Upper Marsh, Lambeth, impd. machine for cutting or forming the tips or points of candles, and for other like purposes.
675. George Wright, of West Burgholt, near Colchester, impd. agricultural implement.
676. Thomas Startin, of Birmingham, impts. in Venetian blinds for carriages, and which said impts. are also applicable to certain blinds or screens for other purposes.
677. Theodor Reissig, of Manchester, impts. in ascertaining the presence of "fixing" agents in photographic productions, in removing the said fixing agents therefrom, and in apparatus connected therewith,—a communication.
679. Albert Westhead, of St. Mary Axe, impts. in apparatus for enabling the passengers in a railway train to communicate with the guard.
680. Joseph Samuel, of Finsbury-square, and Samuel Millbourn, of Oxford-street East, impts. in machinery for preparing flax, hemp, and other fibrous materials requiring like treatment.
681. Richard Percy Roberts, of Petersham, Surrey, impts. in coating the bottoms of iron ships, and other surfaces, to prevent oxidation, the adhesion of marine animals and plants, and in compositions to be therein employed.
682. Joshua Jones and Richard Daniel Jones, both of Chalford, Gloucestershire, impts. in apparatus used for bending the ends of walking sticks and the sticks or handles of umbrellas and parasols.

The above bear date March 10th.

683. Pierre Marvaud, of Paris, impd. apparatus for promptly disconnecting horses from carriages and other vehicles.
684. Charles Johnson, of Oxton, near Birkenhead, impd. combined tee-piece and valve.
685. Edward Brown Wilson and James Howden, both of Glasgow, impts. in steam boilers and the furnaces thereof.
686. Jonas Hird, of Shipley, and Joshua Walker, of Idle, both in

Yorkshire, impd. machinery or apparatus for scouring stones, marbles, slates, and bricks.

687. Julius Garelly, of Paris, impd. machine for cutting button holes.—a communication,

690. Thomas Whitehead and Henry Walton Whitehead, both of Holbeck, Leeds, impts. in machinery or apparatus for hackling flax, hemp, or other similar fibrous substances.

691. James Henderson, of New York, impts. in the process and apparatus for refrigerating or freezing liquids.

692. Edward Brown Wilson, of Glasgow, impts. in furnaces and fire-places.

693. James Murdoch Napier, of York-road, Lambeth, impts. in wine glasses, and in stands or holders for the same.

694. George Carter, of Mottingham Lodge, near Eltham, impts. in the construction of toast racks.

695. John Tann, of Walbrook, impts. in fire and burglar proof safes, chests, doors, and iron rooms.

696. Charles Huntley, of Hackney Wick, impts. in cricket, racket, and tennis balls.

The above bear date March 11th.

697. Robert Martin Roberts, of Dolgelly, impts. in apparatus for treating metals and metallic ores.

698. John Bragg, of Liverpool, impts. in traps to prevent the uprising of noxious gases in sewers, drains, sinks, shafts, and other passages for fœces and other matter.

699. James Atkins, of Birmingham, impts. in the manufacture of metallic bedsteads, which impts. are also applicable to the manufacture of other metallic articles.

700. Joseph Wright, of Dudley, impts. in puddling, heating, and other furnaces.

701. Robert Marsden, of Sheffield, impts. in machinery or apparatus for rolling, shaping, or forging metals.

702. Henry Hill, of Stepney Green, impt. in securing safes and strong rooms.

703. John Webb, of Laurence Pountney-lane, London, impts. in the application and utilization of certain materials suitable for the manufacture of paper,—a communication.

704. William Clark, of Chancery-lane, impts. in apparatus for holding and regulating the position of lamp shades or reflectors,—a communication.

706. William Donald Napier, of George-street, Hanover-square, impts. in apparatus to facilitate dental operations.

707. Robert Gordon Rattray, of Aberdeen, impts. in apparatus for supplying regulated or measured quantities of water and other fluids.

The above bear date March 13th.

708. Francis Augustus Braendling, of Birmingham, impts. in breech-loading fire arms, and in cartridges for breech-loading fire arms,—partly a communication.

709. James Deas, of Glasgow, impts. in, and connected with, levers for railway switches and signals.

710. George Evans, of Notting-hill, impt. in heels for boots, shoes, and other like articles,—a communication.

711. Richard Archibald Brooman, of Fleet-street, impts. in breech-loading fire-arms,—a communication.

713. Auguste Bertsch, of Paris, impts. in apparatus for protecting telegraphic instruments from injury from atmospheric or static electricity.

714. Edmund Dorman Hodgson, of Paper-buildings, Temple, impts. in the construction of safes for securing valuable articles from thieves and fire.

715. Ferdinand Henry Warlich, of Greenwich, impts. in drying and sorting coals, peat, and mineral ores, in separating extraneous matters therefrom, and in apparatus used in those processes.

716. John Wilkie, of Nottingham, impts. in the manufacture of lace or net in twist-lace machines.

717. George Tomlinson Bousfield, of Loughborough Park, Brixton, impts. in apparatus for vaporising hydrocarbon liquids for illuminating and heating,—a communication.

719. Alfred Vincent Newton, of Chancery-lane, impts. in securing low and uniform temperatures, applicable to public and private buildings, also to refrigerators, coolers, and conden-

sers, and to ships and other vessels, and in the apparatus employed therein,—a communication.

721. Isham Baggs, of Chancery-lane, impts. in colour printing, and in apparatus connected therewith.

The above bear date March 14th.

723. William Clark, of Chancery-lane, impts. in electric piles and apparatus, —a communication.

724. Thomas Kennedy, of Kilmarnock, impts. in apparatus for smoke vents or chimneys.

725. Henry Owen, of Leicester, impts. in the manufacture of stockings and other articles of hosiery.

726. Henry Chevob, of Ely-place, Holborn, impts. in keyless watches.

727. William Edward Newton, of Chancery-lane, impts. in apparatus for distilling oils and other liquids from coal and other substances,—a communication.

728. Edward Loysel, of Park-place, Middlesex, impts. in the construction of safes or receptacles for securing and protecting valuable property.

729. Astley Paston Price, of Lincoln's-inn-fields, impts. in obtaining sulphurous acid.

730. John Frederick Brinjes, of Field-gate-street, Whitechapel, impts. in apparatus for cooling animal and other charcoal.

731. Hugh Smith, of St. Stephen's-road, Westbourne-park, impts. in gas engines.

732. Campbell Morfit, of Paris, impts. in treating and purifying oils and fats.

733. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in mail and despatch bags, and bags for other similar uses,—a communication.

The above bear date March 15th.

734. Samuel Bagster Boulton, of Charlotte-row, Mansion-house, impts. in the means and apparatus employed for treating timber with antiseptic or preservative fluids; also applicable to other purposes.

735. Moritz Meisel, of Gloucester-terrace, Old Brompton, impts. in machinery or apparatus for thrashing grain or seed,—a communication.

736. John Ramsbottom, of Crewe, impts. in machinery for rolling and shaping metals.

737. James Farrar and Edwin Booth, of Barnsley, Yorkshire, impts. in machinery and apparatus for mining or working coal and other minerals.

738. William Loeder, of New Broad-street, impts. in the permanent way of railways,—a communication.

739. Joseph Seaman, of Worcester, impt. in harrows, drags, cultivators, and other similar implements to be used in the cultivation of the soil.

740. Robert Bell, of Carlisle, impts. in working railway signals, and in the machinery or apparatus connected therewith.

741. William Brookes, of Chancery-lane, impts. in musical instruments, —a communication.

743. Alfred Vincent Newton, of Chancery-lane, impts. in the construction of steam generators and evaporators,—a communication.

The above bear date March 16th.

744. John Standfield, of Thames Bank-house, Pimlico, impts. in differential wheel gearing.

746. Charles Anthony Wheeler, of Swindon, impd. apparatus combining a pencil, shield, and India rubber.

747. Henry Wethered, of Bristol, impts. in heating preparatory to, and for the purpose of, hardening or tempering of knives, files, tools, and all other descriptions of cutlery or hardware usually subject to the process of hardening or tempering.

748. Benjamin Lawrence, of Coleman-street, City, impts. in increasing the mechanical value of steam as a motive agent,—a communication.

749. George Dibley and Frederick Braby, of Fitzroy-works, Euston-road, impts. in posts or supports for telegraph wires, also applicable to posts or supports employed for other purposes.

750. James Bullough, of Baxenden, Lancashire, impts. in looms for weaving.

751. Jacob Goodfellow, of Blackburn, impd. combinations of direct-acting steam engines, with single or double acting pumps for pumping water, air, or gases.

752. William Maurice Williams, of West Ham, impd. method of treating, cleaning, or preparing painted or other canvas tarpaulins, and dirty cotton waste, so as to render the same suitable to be used for household and other purposes for which they may be applicable.
753. Alfred Vincent Newton, of Chancery-lane, impts. in the construction of bracket, pillar, and suspended lamps and lanterns,—a communication.
754. William Roberts, of Millwall, impts. in cocks or valves.

The above bear date March 17th.

755. James Cookson and Philip Billington, of Rusholme, near Manchester, impts. in apparatus for blowing smiths' and other fires.
756. Thomas Ogden, of Higher Broughton, near Manchester, impts. in lap machines, employed in preparing cotton and other fibrous substances.
757. James McConnell, of Westhoughton, impts. in platform weighing machines.
759. Edwin Pilling and John Harper, of Rochdale, impts. in weft stop motions for looms.
760. James Henry Wathew, of West Bromwich, impd. machine for peeling or skinning almonds.
761. Joseph Walls, of Manchester, impd. arrangements and apparatus for drawing off liquors or liquids from casks and other vessels without the aid of pumps.
762. Thomas Kenyon, the younger, of Manchester, impts. in preparing, fixing, and mordanting cloth and yarns.
763. Francis Wise, of Chandos-chambers, Adelphi, impts. in mechanism for attaching buttons to fabrics,—a communication.
764. James Vero, of Atherstone, Warwickshire, impts. in brushes or brooms.
765. James Cochran Stevenson, of South Shields, impts. in the preparation of hyposulphite of lime.
766. Owen Robinson, of Kettering, impts. in sewing machines.
767. Charles William Spark and Thomas Sprawson Cross, of the city of London, and William Adkins, of Birmingham, impts. in portable or fixed machines for the manufacture of bricks and tiles, whether plain or for ornamental purposes.
768. John Howard Kidd and James Chadwick Mather, of Manchester, impts. in floor-cloth, and in machinery for the manufacture of floor-cloth.

The above bear date March 18th.

770. Thomas Oliver, of Dalston, and Joseph William Musto, of Mile End, impd. top or mouthpiece for cigars or cheroots.
771. Johann Tobias Romminger, of Dresden, impts. in apparatus for generating steam,—a communication.
772. John Thomas Cook and John Thomas Cook, the younger, of Birmingham, impts. in breech-loading fire-arms.
773. Matthew Eley, of Laurence-lane, Cheapside, impts. in gentlemen's scarfs.
774. Isidor Philippsthal, of Berlin, impts. in the manufacture of yarn, so as to render the same applicable as a substitute for woollen yarn for manufacturing into shawls and other textile fabrics.
775. Arthur Giraud Browning, of Victoria-street, Westminster, impd. socket for fencing and telegraph posts.
776. Alfred Vincent Newton, of Chancery-lane, impts. in sewing machinery,—a communication.
777. Robert Thompson Crawshay and Isaac Arriston Lewis, of Cyfarthfa Ironworks, Glamorganshire, impts. in the manufacture of puddled iron bars, and every description of malleable iron.
778. Samuel Chatwood, of Bolton, impts. in locks for safes, strong rooms, and other purposes.
779. William Menelaus, of Dowlais Iron Works, Glamorganshire, impts. in machinery for working puddled balls, or blooms of iron and steel.
780. Alexander Richard Mackenzie, of Manchester, impts. in locomotive engines and carriages for common roads and tramways, and also for agricultural and other purposes.

The above bear date March 20th.

781. Charles Hill Pennycook, of Glas-

gow, impts. in constructing gasometers, tanks, casks, and similar vessels.

782. James Waterhouse Midgley, of Cononley, Yorkshire, impd. means or apparatus for lubricating vertical or diagonal spindles and shafts.

784. Daniel Gourley, of Hornsey, impts. in the manufacture of boots and shoes.

785. Charles Farmer and Thomas Turner, of Birmingham, impts. in machinery and appliances for the manufacture of nails, pins, and rivets.

787. William Arthur, of Atherington, Devonshire, impts. in compasses or apparatus for registering the course steered by a vessel during any given period.

788. Richard Archibald Brooman, of Fleet-street, impts. in the preparation of hydrated oxide of chromium, —a communication.

789. William Clark, of Chancery-lane, impts. in apparatus for cutting pasteboard and other like boards,—a communication.

790. Richard Jordan Gatling, of Indianapolis, U.S.A., impts. in fire arms.

791. James Smith, of Seaforth, near Liverpool, and Sydney Arthur Chease, of Egremont, Cheshire, impd. arrangement of valves and other appliances for a new description of hydraulic engine for raising water and other fluids above their common level, the fluids so raised to be used as a motive power.

792. William Berry, of Willow-place, Stamford-hill, apparatus for cutting bread, or bread and butter.

793. Bernard James Webber, of Newton Abbot, impts. in machinery for thrashing and rubbing barley and other grain.

The above bear date March 21st.

794. Hiram Smith Jacobs, of Portland, Oregon, U.S.A., impd. machine for dressing and rounding the inner surfaces of felloes.

795. George Farmer, of Old-street, impts. in machinery for cutting, punching, raising, shaping, or drawing through sheet metal by means of tools and dies.

796. William Mattieu Williams, of The Celyn Caergwrle, near Wrexham, impts. in apparatus for the distillation of coal and peat, and such other substances as are or may be used for the manufacture of solid and liquid volatile hydro-carbons, or for the manufacture of the said hydro-carbons and coke.

797. Harold Potter, of Manchester, impts. in treating the waste liquors obtained in bleaching certain vegetable substances.

798. William Lane, of Old Kent-road, impd. mechanism or apparatus for propelling carriages and other road vehicles by hand power.

799. William Juby Coleman, of Bury St. Edmunds, impd. composition for clarifying and fining beer and other fermented liquors.

800. Alfred Pierre Tronchon, of Paris, impts. in the construction of fire-arms, and in cartridges for the same.

801. William Clarke, of Nottingham, impts. in the manufacture of fabrics in lace machinery.

802. Valentine Baker, of Cahir, Tipperary, impts. in obtaining motive power.

803. John James Carter, of Wellington-road, Holloway, impts. in the manufacture of jewellery cases, and other similar cases.

805. James Wright, of St. Paul's-crescent, Middlesex, impts. in the process of preparing kaolin or china clay, and other clays for potters' use, and for expelling water from other earthy deposits,—a communication.

806. Morgan Morgans, of Brendon-hills, Somersetshire, impts. in the manufacture and refining of iron and steel.

807. Richard Archibald Brooman, of Fleet-street, impts. in engraving on metal,—a communication.

808. George Edmund Donisthorpe, of Leeds, impts. in apparatus for washing wool, hair, and other fibre.

809. William Morrant Baker, of Furnival's-inn, impts. in Argand gas burners.

The above bear date March 22nd.

810. James Macaulay and Robert Watson, of Paisley, impts. in weaving ornamental fabrics.

812. Edward Field and Francis Wise, of Chandos-chambers, Adelphi, impts. in machinery or apparatus

for feeding paper to printing machines, and for taking off or removing and piling the same after printing.

814. Charles Henry Crowe, of Gloucester-road, Regent's-park, impts. in stoppers for bottles, jars, or other vessels, the same being applicable to fire-arms and ordnance.

815. Duncan Mackenzie, of Graham-road, Dalston, impts. in machinery and apparatus for indicating, selecting, and reading in such cords of designs or patterns as are transferred and perforated on cards, papers, or their substitutes, and for reproducing and repeating duplicates of such operations on such materials for jacquard machines.

816. Louis Augustus Leins, of Bucklersbury, impd. apparatus for securing the frame carrying the fittings in travelling bags.

817. Richard Archibald Brooman, of Fleet-street, impts. in treating fats and fatty matters for the manufacture of candles,—a communication.

820. Henry Oakes, of Wakefield, impts. in worsted, carding, and preparing machinery.

821. Joseph Lees, of Norwich, and Moses Mellor, of Nottingham, impts. in machinery or apparatus employed in the manufacture of cloth and other fabrics.

824. George Henry Castree and John Alfred Castree, of Manchester, impts. in looms for weaving.

825. Robert Tidman, of Jermyn-street, impts. in machinery or apparatus for paying-out and for raising electric telegraph cables in deep waters.

826. James Clifford Morgan, of Rotherham, impts. in stoves or fire-places, ash pans, and fenders.

827. Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, impts. in obtaining motive power from aëriform fluids and from liquids.

The above bear date March 23rd.

829. Charles Bevan, of Margaret-street, Cavendish-square, impts. in cabin furniture for ships and other vessels.

The above bear date March 24th.

New Patents Sealed.

1864.

2345. W. Carter.
2349. W. Greener.
2352. J. T. Stroud.
2353. R. Hattersley.
2354. G. P. Wheeler.
2357. W. Scott.
2363. Joseph Hill.
2367. H. C. Symons.
2368. W. H. Orth.
2369. G. B. Cornish.
2370. R. A. Brooman.
2373. K. H. Lane.
2375. Jas. Lister.
2378. G. Davies.
2380. W. Whitehead.
2384. F. and W. Weems.
2386. H. A. O. Mackenzie.
2388. G. W. Allen.
2395. S. Alley.
2399. G. Allix.
2400. R. A. Brooman.
2401. G. Lindsley.
2402. G. H. Harrington, H. Hewetson, and F. Y. Hewetson.
2407. A. A. Croll.
2410. W. H. Graveley.
2414. W. E. Newton.
2415. W. Clark.
2417. J. S. Grimshaw.
2418. Peter Winton.
2422. J. H. Johnson.
2423. F. N. Gisborne.
2428. R. A. Brooman.
2432. Richard Laming.
2438. T. A. Swinburne.
2440. Thomas Dobson.
2441. Alexander Monro.
2446. H. A. Bonneville.
2449. J. O. Communs.
2456. Frederick Tolhausen.
2458. Thomas Turner, Jun.
2465. P. A. le Comte de Fontainemoreau.
2467. J. P. Turner.
2470. W. Clark.
2471. George Davies.
2473. C. Chapman.
2481. H. S. Coleman & A. G. E. Morton.
2488. R. M. Hands.

2484. J. G. Beckton.
2487. John Cassell.
2492. James Webster.
2494. E. H. Huch and F. Windhausen.
2495. T. Lambert and H. C. Soper.
2497. J. I. Vaughan.
2498. B. H. Jones.
2500. W. Gilbert, E. Cooper, and G. R. Webster.
2501. G. H. Reay.
2502. Thomas Adams and G. J. Parson.
2503. J. W. Nottingham.
2508. W. B. Haigh and S. Barlow.
2510. Frederick Wilkins.
2511. Johannes Möller.
2522. Edouard Meride.
2526. R. A. Brooman.
2527. Michael Henry.
2529. J. T. Cook.
2532. W. E. Gedge.
2533. W. R. Sykes.
2534. Alexander Hippius.
2538. Richard Wright.
2540. A. L. Hopson and H. P. Brooks.
2541. W. Clark.
2542. W. H. Kelsey.
2549. Henry Mason.
2551. Edward Baines.
2554. E. Tomlinson and J. Jones.
2555. F. A. Calvert.
2557. C. T. Judkins and W. H. Gosling.
2558. Thomas Corbett.
2559. A. Hill.
2560. John Cassell.
2562. Michael Henry.
2564. Joseph Maurice.
2568. S. Howard and W. Wood.
2570. John Hart.
2574. Charles Pettit.
2580. W. Gilbert and F. W. Gilbert.
2581. W. Taylor, H. Harrison, and G. Brown.
2583. William Buxton.
2585. Thomas Turner, Jun.
2586. Auguste Clavel.
2589. Frederick Walters.
2596. W. E. Newton.
2605. Laurent Paviola.
2611. Thomas Allcock.
2613. J. G. Jones.
2627. S S. Anderson.
2629. George Schorb.
2634. William Clark.
2644. William Clark.
2646. Pater Dubulle.
2649. J. Hall, W. Dunkerley, and S. Schofield.
2656. P. A. le Comte de Fontainemoreau.
2676. J. Hartshorn and J. Gadsby.
2677. H. A. Jowett, J. E. Jowett, and J. B. Muschamp.
2681. L. P. G. Bellet and C. M. P. De Rouvre.
2685. J. L Norton.
2686. G. H. Devereux.
2699. Thomas Ivory.
2707. George Ashcroft.
2745. H. V. Scattergood.
2760. A. V. Newton.
2761. C. T. Burgess.
2763. G. P. Harding and L. Thomas.
2786. W. E. Newton.
2792. M. W. Ruthven.
2793. E. J. W. Parnacott.
2800. William Willis.
2809. Francis Fearon.
2896. James Easton, jun.
2906. A. V. Newton.
2940. Louis Valant.
2983. W. J. Matthews.
3006. William Clark.
3059. Edward Myers.
3087. A. Pemberton and J. Ford.
3088. A. V. Newton.
3130. B. Dobson, W. Slater, and R. Halliwell.
3184. R. L. Howard and J. Daghlish.
3199. W. H. Maitland.
3215. W. E. Gedge.
3228. R. H. Leese.
3241. P. C. P. L. Prefontaine.

1865.

45. J. Crow and J. Macaulay.
155. W. R. Foster.
156. S. F. Van Choate.
157. C. D. Abel.
185. A. J. L. Gordon.
203. A. C. F. Derocquigny & D. Gance.
204. C. T. Wells.
207. George Haseltine.
209. W. Woodward, R. Woodward, J. Woodward, and A. Woodward.
229. J. G. Willans.
244. J. H. Johnson.
257. William Foster.
330. A. A. Hulot.
364. John Chubb.
375. Alfred Krupp.
381. G. Coles, J. A. Jaques, and J. A. Fanshawe.
389. T. A. Verkruzen and M. A. Verkruzen.
422. George Homfray.
438. G. F. Bousfield.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S

London Journal of Arts and Sciences.

No. CXXVI. (NEW SERIES), June 1st, 1865.

COAL: THE MANNER OF ASCERTAINING ITS HEATING POWER.

Article IV.

With every shipment of coals at Newcastle, it is customary for the fitter to make a declaration to the effect that the article then shipped is "fresh wrought" from the mine: a tacit acknowledgment on his part that the coal is supposed, in some way or other, to deteriorate by keeping. Nor is this supposition the result of mere prejudice, for it is an established fact, although, like many other facts, it is far too little known and appreciated by the public at large. Coal of every description deteriorates by being kept in contact with the air, and some kinds suffer much more rapidly than others; but all are liable to damage from two causes, that might not inaptly be called the "dry" and the "wet rot." Thus, when coal is exposed to the air, its surface, and to a certain extent its substance, becomes oxidized, by which it gains in weight, but loses in calorific value; in fact, we might say that a part of it is burnt, but not removed: this is the "dry rot." Then, again, when coal in large heaps or masses is moistened, it undergoes a sort of fermentation or heating, which expels a portion of the hydrogen, and oxidizes a part of the remainder, so as very much to diminish the heating power of the coal: this is the "wet rot." Upon some varieties of coal these changes are extremely slow, whilst upon others they take place with great rapidity, and, to an extent that may well be regarded as very serious in a pecuniary point of view. The fact itself, however, appears to be altogether ignored by our governmental authorities, for it is never once alluded to in any of our "blue-book reports" upon fuel; and it unfortunately happens that there are no physical or external indications in the appearance of the several descriptions of coal by which we might, upon inspection, form an

opinion of the keeping quality of any particular sample. We ourselves have made many experiments upon this deterioration, and are therefore able to say, that generally speaking the heating power of dry coal is diminished in the ratio of 13 to 12 by a six months' exposure to the air and the ordinary action of daylight; but when the coal is moistened, the loss becomes much greater, and even this is evidently increased if the bulk of the material is very large, so that in such a case the coal seems gradually to be converted into mere lignite, at the expense of nearly one-half of its calorific value. That a list of the different kinds of coal, with a well-authenticated table of their deteriorating quality, would be a great boon to the coal-consuming public, needs no argument at our hands. The practice of the coal-fitters at Newcastle is a sufficient proof of the importance and necessity for some such guide, and there we leave it.

Having thus disposed of the history of coal, of its origin or production, of its ultimate analysis, and of its elementary composition, we now approach the really practical bearing of our inquiry—

The Heating Power of Coal.

If the heating power of coal could be deduced from a knowledge of its constituent parts, then an elementary analysis would become practically useful, although such a mode of determining the value of coal would still possess this disadvantage—that the power of ascertaining such value must rest in the hands of a very few skilled experimentalists. But a knowledge of the composition of coal will not enable us to infer its calorific quality. Nor need we be surprised at this. When carbon and gaseous hydrogen unite together to become solid, it is clear that the latent heat of the gaseous hydrogen must be set at liberty and lost; consequently, a solid compound of carbon and hydrogen being burnt, will always evolve just so much less heat than the same substances disunited, as is requisite to convert the hydrogen from a solid into a gaseous form; and that the heat required for this conversion must be very great, is proved by the high continuous temperature needed in the manufacture of coal-gas, during which operation the hydrogen of the coal is, in effect, converted from a solid into a gaseous condition. Hence the law of Welter has proved to be quite useless in the case of hydrogenous combustibles. Convinced of the truth of this fact, though seemingly ignorant of the principle, the celebrated French chemist Berthier invented a method which has been very much relied upon in France, and in some other countries. It is based upon the power, which many inflammable substances possess, of deoxidising the protoxide of lead at a red-heat, so that when the inflammable substance and the protoxide

of lead or litharge are heated together in suitable proportions, a quantity of metallic lead is produced, from the weight of which the heating power of the inflammable substance is surmised. But this process, applied to coal, is liable to two errors:—In the first place, it makes no allowance for the lost latent heat of the hydrogen; and, in the second place, a variable portion of the volatile inflammable ingredients is driven off and lost, before the heat applied to the mixture has become sufficiently strong to insure the decomposition of the litharge. The plan of Berthier has, therefore, been for some time abandoned, even in France; whereas, in this country, no other method than a rough and extremely inaccurate set of trials, made in an invariable kind of furnace, placed under an invariable kind of boiler, and attended to by common workmen or stokers, has been regarded as worthy of public, or, at least, of governmental confidence.

Of the two methods here described, we have no hesitation in saying that the plan of Berthier is by far the best; for, whatever its errors may be, it seeks at least to ascertain the total calorific power of the fuel; whereas, the English method attempts only, by an extremely arbitrary and imperfect set of experiments, to arrive at a comparative indication of something called "the heating power of coal," although by this method it seldom happens that more than one-half of the actual heating power of the coal is ever obtained. This English plan of testing coal, which, by-the-bye, has the approval of our Admiralty, has been framed upon the procrustean system of practical philosophy. The coal is made to fit the furnace, the boiler, and the ignorance of the experimenters. If, however, the only disadvantage of this system rested upon the coal-owners, it might be tolerated; for, after all, it ends in a process of compensation, and what is unfairly taken from one coal-owner is unfairly given to another. But, meantime, the country loses a great deal by this folly, because it serves to arrest the idea of improvement in the burning of fuel. For instance, if any boiler-maker or furnace-improver finds that with a certain kind of coal he can boil off water—equal say to 8 times the weight of the coal—and referring to the Admiralty data he sees that this is the Admiralty value of the coal, all idea of improvement vanishes; he is satisfied that he has reached the "ultra thule" of calorific power. Did he, however, know that only the half of that power had been utilised, a disposition would arise to discover a method of combustion better adapted to secure an increased effect. Hence, the plan of Berthier is better, for its object is the true one, though it fails to reach this object.

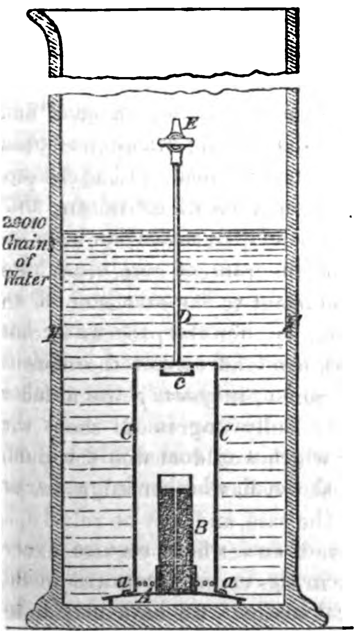
That a knowledge of the total heating power is indispensably necessary to those who are in search of improvements in the economy of

fuel, needs no demonstration; for who can doubt that every manufacturer ought to know the quantity of pure goods existing in the raw material he employs? Imagine, for example, a copper smelter ignorant of the amount of pure copper in the crude ore which he casts into his furnace! Yet this is the condition of the public mind in regard to the consumption of fuel; and until this benighted condition is removed, the whole intellectual force of the kingdom cannot be said to have been employed upon this thoroughly national question. At present, it is impossible for any inventor to know when he has reached, or how far he is distant from, perfection in the burning of coal; consequently, it is impossible for him to determine the particular kind of furnace, and the peculiar arrangements in the boiler, needed for the different varieties of coal. He must toil on in the dark, or, as the French say, "tâtonner," to get an improvement; and when he has got one, he may not be able to find out whether it arises from an improvement in the furnace, or in the setting of the boiler, or in the draught of the chimney, or in all three, or in only two of these combined. If, therefore, he ventures to take out a patent for his invention, the odds are that his specification is defective.

With a view to remedy this long-existing evil, we made a most elaborate set of experiments, in the years 1850 and 51, upon the heat given out during the combustion of different kinds of coal in pure oxygen gas. The results of this labour may be found in Dr. Ure's "Dictionary of the Arts," &c., Vol. I., page 824, and are singularly correct, considering the great difficulty of the process employed. But this very difficulty has formed an impediment to the extension of the knowledge thus furnished to the community; for the process is quite beyond the range of the ordinary workman, and cannot therefore be verified at the hands of the million: it cannot, in short, be regarded as anything but a chemical experiment. Fully impressed, then, with the national importance of a discovery which would enable the public at large to determine the value of coal, we have invented a method which answers all the requirements of the case, and may be relied upon with the utmost safety. Its results have been verified by a vast number of practical experiments, made not only in this country, but also in Belgium, France, and the United States of America. Consequently, we are able to offer it for general adoption, with the greatest confidence, not merely from the demonstrated accuracy of the process, but because this is so simple and easy of execution as to create no impediment whatever to its practical employment: a recommendation that, in our opinion, is of the highest importance towards the solution of any question bearing upon the manufacturing interests of society, where the

means of obtaining an actual knowledge of a fact are vastly preferable to the insecure belief in a scientific assertion.

In adapting the apparatus, which we are now about to describe, to its use, it was found necessary to determine what is called the "latent heat of steam," that is to say, the amount of heat required to convert any given quantity of boiling water into steam. Upon this point considerable diversity exists in the calculations of scientific men. Thus, Watt fixed the latent heat of steam at 943; Despretz at 956; Ure between 966 and 990; Clement and Desormes at 990; and others even still higher. Perplexed by this undecided state of the subject, we made more than 200 experiments, to determine for ourselves the latent heat of steam, and have selected 967 as the number best suited to our present wants. Our apparatus for testing the heating power of coal is shown, in vertical section, in the accompanying cut. It consists essentially of but three pieces, so far as novelty in construction is concerned, for all the other parts may be bought, ready made, at any philosophical instrument maker's. The three pieces are named according to their use: first, the stand; second, the furnace; and third, the holder. The first is a heavy circular plate of copper A, provided with three catches *a*, *a*, by which the holder is attached to it; the second is a small cylinder of copper B, closed at one end only, and capable of holding about 350 grains of water; the third is a large, hollow cylinder C, made of thin sheet copper, and closed at one end, where it is furnished with a small tube D, having a stop-cock E; this tube, at its opening into the cylinder, being covered by a small arch of sheet copper *c*, so as to secure the tube from obstruction. The bottom, or open end of the hollow cylinder C, is provided



with a flange, in which notches are formed, corresponding to the catches on the holder, to enable the flange to be inserted below the catches. Immediately above the flange the cylinder is pierced with a ring of small holes, for the escape of the gaseous products of the furnace. The whole of the three pieces, when joined to-

gether, charged with coal, and lighted, may be looked upon as a small, enclosed fire-place or furnace; and in this condition it is placed under cold water in a suitable vessel F, so that all the heat generated is absorbed by the water, and can be measured. But the quantity of this cold water is so arranged as to be proportional, not only to the amount of coal consumed, but also to the kind of thermometer used in this country—that is to say, to Fahrenheit's scale. We will now explain this arrangement, upon the supposition that the latent heat of steam is 967. If any given quantity of water contained in an open vessel were put upon a white-hot metallic plate, the heat of which was kept uniform, then the heat from the plate would pass into the water, and ultimately cause it to boil, and evaporate in the form of steam. Let us suppose, then, that the temperature of the water, at the commencement of this experiment, was 62°, and that it required 150 seconds of time for the heat from the white-hot plate to cause the water to boil, or to reach the 212th degree of Fahrenheit, then it is clear that the water has gained 150 degrees of heat in 150 seconds; or, in other words, that the heat given off by the white-hot plate is at the rate of one degree for every second. But if now we watch the time required to evaporate the whole of this boiling water, we shall find that it takes 967 seconds: that, in fact, the boiling water has been converted into steam by absorbing 967 degrees of heat. If, therefore, we take one grain of coal, and burn it in a vessel containing 967 grains of water, and we find that the heat of this water has been increased one degree, it is obvious that this one grain of coal must have given off 967 degrees of heat; or that in burning it would boil off its own weight—that is, one grain of water. If, however, the water has become two degrees hotter, then the coal must have evolved sufficient heat to boil off two grains of water, and so on *pari passu;* the number of degrees of heat imparted to the water indicating in all cases the number of grains of water which this one grain of coal would boil off, or in other words the heating power of the coal, whether in grains, or pounds, or tons.

But as the weighing of a single grain of coal would require a very delicate balance, and any loss or inaccuracy in its treatment would lead to great errors in the subsequent calculations, we have chosen to operate upon 30 grains of coal, and consequently to employ 30 times 967, or 29,010 grains of water as the quantity in which to immerse our apparatus during the burning of the coal, so that every degree of heat communicated to this water indicates the evaporative power of the coal in proportionate quantities, whether grains, pounds, or tons. Thus it must now be apparent that our process amounts to no more

than the simple burning of fuel in a kind of diving-bell, so contrived as to cause the products of combustion to pass through certain small holes, like those in Davy's safety lamp, by which the heat is abstracted from the gaseous matters, and, in the case of our apparatus, transferred to a given quantity of water, where it is afterwards measured. The combustion of the fuel in the diving bell is brought about by mixing it previously with an amount of chlorate of potash sufficient to yield the oxygen required to consume the fuel, just as in ordinary cases the atmosphere furnishes the oxygen needed for our fires and furnaces. To complete our apparatus we must, however, provide a tall glass vessel, about 18 inches in height and 4 inches in diameter; a thermometer, ranging from about 32° to 120° Fahr.; a pair of scales and weights; and, lastly, a small cast-iron mortar, in which to mix the fuel and other combustible ingredients. The glass vessel should have a mark put upon it, at the point or water-line, made when 29,010 grains of pure water of the temperature of 60° are placed in it, for, by this mark, we shall afterwards be enabled easily to charge the vessel with water; and if we pour off this water, and warm it to 100°, then return it back into the glass vessel containing the furnace, we shall see, by means of the thermometer, how much heat is absorbed by the glass and copper vessels, because this absorption of heat must be allowed for, and added to the results obtained by experiment. This allowance is generally from 10 to 14 per cent. With regard to the scales and weights, it is requisite only that the scales may indicate or turn with one-tenth of a grain, and that the weights may be from 1 to 500 grains: the cast-iron mortar may be of a size to hold one pint of water. The thermometer might very conveniently be made of a peculiar construction, but the extravagant price demanded by the makers of these instruments for even the slightest change in constructing them, renders it advisable to employ the common kinds. We have made for our own use a thermometer with a sliding scale, divided into tenths of a degree, so that by placing the zero of this scale at the point accidentally formed by the cold water employed at the time, we can read off, after the combustion of the coal, its experimental heating power in pounds and tenths of a pound. But to do this with a common thermometer we must notice, first, the temperature of the water, which may be, say 58°; then, after the combustion, again notice the temperature of the water, which may be, say 71½°; the difference of these, or 13½, is in that case the heating power of the coal by experiment, to which, if we then add, say 10 per cent., for the heat absorbed by the glass and copper vessels, we have 14·85 as the number of pounds of water which one pound of this coal would

evaporate; or, in other words, 14·85 is the total heating power of the coal in question.

To insure the satisfactory testing of a sample of coal or other combustible matter, we begin by making up a quantity of "chlorate mixture," or, speaking less technically, the saline mixture by which oxygen is supplied to the combustible body under examination. This mixture is composed of three parts by weight of chlorate of potash, and one part of nitrate of potash, both mixed together, and reduced to an impalpable powder, which powder must be kept in a stoppered bottle to prevent its admixture with dust and other fuliginous substances. Thus provided, we take about three pounds of the coal to be tested, and reduce these to the condition of a coarse powder like sea-sand, from which we abstract about one hundred grains, and pulverise this in the mortar until it is so finely divided that the particles begin to adhere together as if they were moist. This condition is readily comprehended after a little practice, and forms an excellent indication of thorough subdivision. From the one hundred grains of coal thus powdered, we must now weigh out thirty grains, and carefully incorporate these with three hundred grains of the chlorate mixture; the whole must then be put into the furnace and compressed, so as to form a solid mass, and a hole must be made through the centre of this mass to the bottom, by means of a pointed rod or wire. The object of this hole is to induce the combustion to proceed from the centre to the circumference of the mass, so as not to make the furnace red hot and cause a too rapid combustion, or the projection of part of the mass in an unburnt state. In the upper part of the hole just mentioned, a small fusee is to be fixed. This fusee is made by immersing common cotton cord in a saturated solution of nitrate of lead, and then drying the cord, of which a piece, about one inch in length, is to be fixed, as above stated, so that three-fourths of it may project from the mixture of coal and chlorate. Thus prepared, the furnace is charged and ready for use. We now fill the glass vessel with cold water, to the point marked upon it, and carefully notice the temperature of this water. At the same time we place the furnace upon the stand, and, having lighted the fusee, cover this with the holder, and secure the whole quickly by the catches; after which, the stop-cock being closed, we immerse the holder in the water, and there leave it. In the course of about half-a-minute combustion begins, and a dense white smoke bubbles rapidly from the small holes in the holder through the cold water. When this ceases, the stop-cock must be opened and the holder moved about in the water, so as to insure complete admixture. The temperature of the water must then be again carefully taken, and the two re-

sults compared together, as already explained, the difference being the experimental heating power of the coal. In this description, we have given ten times the weight of the coal, or three hundred grains, as the proper quantity of chlorate mixture, and such a quantity is the amount needed for all our ordinary kinds of coal. But it is evident that this quantity must be in some degree proportioned to the nature of the combustible body under examination, and, therefore, no fixed proportion can be given: thus, with lignite, two hundred grains are amply sufficient; whereas, with New Brunswick Albertite, three hundred and fifty grains are needed. Under all circumstances, no black or unconsumed matter ought to remain in the water after the experiment is finished, for this arises either from a deficiency of chlorate mixture, or, what more frequently happens, an imperfect pulverisation of the combustible body and its non-admixture with the chlorate. The perfect pulverisation of coke is, indeed, a remarkably difficult task, and hence it is not easy to make a satisfactory experiment upon this substance. Those who are acquainted with the manufacture of gunpowder and fireworks will readily appreciate the nature of this difficulty, and its importance upon the result.

With respect to the heat given off by the fusee, we will merely say, that after consuming fifty inches of this cotton cord or fusee in the holder under water, no change could be seen in the temperature of the water, although a remarkably delicate thermometer was used to detect the difference.

As a proof that an apparatus such as we have described might be usefully carried by sea-going steamers, we relate the following incident:—A very few years since, one of our government steam vessels having run short of fuel, put into the Island of Disco, and there obtained an abundant supply of what was supposed to be "canal coal," to which, in general appearance, it had some resemblance. The quantity taken on board was presumed to be quite sufficient to carry the vessel home to Woolwich, but it proved otherwise, for mid-way it was discovered that the coal was burning away so rapidly that the steamer must soon become short of fuel. The condition seemed serious; but, fortunately, there were several casks of tallow on board, and this tallow was, therefore, prudently mixed with the fuel, so that the vessel reached England in safety. We were favoured with a small sample of this so-called Disco coal, and soon found that its heating power was only 8·5, or little more than one-half the heating power of good English coal; in fact, the Disco mineral was not coal at all, but merely lignite, and hence the quantity taken on board was vastly too small for the requirements of the voyage. A single experiment at Disco would have prevented this miscalculation.

Appended is a list of the heating powers of different kinds of coal and other bodies, as we have found them:—

Name of Coal.	Heating Power.	Name of Coal.	Heating Power.
Wearmouth Deep Pit	15·6	Wigan Canal	15·4
Russell's Wallsend	15·9	Ince Hall Canal	15·4
Brown's Wallsend	15·6	Gloucester Low Delph	13·9
Bewick and Crastor's Wallsend	15·6	Derbyshire Coal	13·4
Heaton	15·6	Staffordshire Coal	14·2
Killingworth	15·2	Ruabon (North Wales)	14·6
Gosforth	15·4	Brymbo ditto	14·5
Burradon	15·2	Anthracite (South Wales)	15·4
Bensham	15·5	Anthracite (Ireland)	15·3
West Hartley	15·3	Anthracite (Scotland)	15·7
Bates' Hartley	15·3	Anthracite (France)	14·8
Hastings' Hartley	15·4	Lesmahago Canal (Scotland)	13·9
Hetton's Wallsend	16·0	Boghead Canal (ditto)	14·5
Lambton's Wallsend	15·8	Neath Coal (South Wales)	14·9
Rainton	15·8	Somersetshire Coal	14·2
Blyth	15·6	Coal from Saxony	14·5
Primrose Main Coal	15·2	Coal from Belgium (1)	14·0
Eden Main	15·1	Ditto ditto (2)	14·1
Pelton	15·2	Coal from North of France	14·0
Garesfield (Butes')	15·4	Grande Combe Coal (S.W. of France)	15·2
Washington	15·4	Marseilles (Lignite)	11·5
Ramsey's Canal	14·3	Coal from Spain	14·4
Tanfield Moor	15·3	Coal from North America	14·7
Pontop (Windsor's)	15·4	Anthracite from ditto	15 2
Felling Main	15·7	Albertite (New Brunswick)	17·5
Washington Canal	15·0	Valparaiso Coal	14·8
Holmside Coal	15·5	Coal from China	12·8
Arley Wallsend	15·5	Coal from India	13·1
Lawton and Harecastle Canal	14·2	Coal from Australia	14·4
Bouling's Black Bed Coal	14·9	Lignite (Devonshire)	9·1
Beeston Park Coal	14·3	Retinite (Bovey Tracy)	12·0
Rock Coal	14·1	Lignite (Isle of Disco)	8·5
West Staveley Coal	15·0	Saw-dust dried at 300° Fahr.	8·8
Dampton Bed	13·5	Pure Sugar	8·0
Woodthorpe	14·1	Part of the Trunk of a Tree found deeply buried in a bog	7·3
Mortemley	14·1	Common Charcoal	13·6
Barnsley Coal	15·5	Pitch from Boghead Canal Coal	15·1
Elsecar Coal	14·0	Coke from Caking Coal	13·8
Coal Pit Heath	14·6		
Lintz Newcastle Coal	15·3		

Many of these samples of coal have been preserved in stoppered bottles since the year 1850, and some of them even longer than this: for instance, the Russell's, or original Wallsend coal, has been thus preserved since the year 1825.

In conclusion, we will offer a few remarks upon the smoke-phobia. Those who object to coal smoke or soot because it is black, unsightly, and disagreeable, have much reason for their objection; and if they are unable to balance the annoyances of coal with its advantages as a fuel, we see no hope of ever replying to their complaints; for, beyond doubt, soot is filthy in the extreme, has a disgusting odour, and disfigures everything it comes in contact with.

But there are some people who wish to persuade the public that the formation of this soot entails an awful loss of heating power, and is moreover a terrible agent in the production of disease and death. After a long series of trials under a steam boiler, specially fitted up for the purpose, we found that, when burnt in the usual way, one ton of coals furnished 25lbs. of soot, and the heating power of this soot is almost exactly 4-5ths of the heating power of the original coal; consequently, the loss of heating power from soot is less than 1 per cent., or, more correctly, 1-112th part.

It is, however, not so easy to deal with the sanitary part of the outcry, for this cannot be submitted to the rigid test of experiment. That soot or carbon in every shape possesses remarkable disinfecting and purifying powers, is sufficiently proved by the use of common charcoal for purifying water; peat charcoal for purifying fluid sewage; and animal charcoal for purifying and decolouring sugar. Nor need there be any doubt about the fact that soot very materially tends to purify and disinfect the atmosphere of our cities; especially as a comparison of the mortality of our coal-smoked towns shows a decided average in their favour, over the wood and charcoal-fumed towns of the continent. But this is not enough for the traffickers in smoke-phobia: like Falstaff, they will continue to follow their "vocation," and gain a living out of the ignorant fears of the public, until the diffusion of scientific knowledge renders their existence impossible. And this knowledge will reveal another fact well worthy of attention. From the laziness and ignorance of our common stokers, the bars of our furnaces are mostly so over-charged with coal, that perfect combustion can take place only at the point where the fuel touches the bars: thus the upper portions of the coal are as effectually distilled, and their unburnt gaseous parts as completely expelled, as if enclosed in a gas retort. Practically, therefore, all the volatile portions of the coal are in this way lost, and nothing is consumed but the coke or cinder. L. T.

THE EDINBURGH REVIEWER AND THE PATENT LAWS.

The enmity which the Patent Laws have created for themselves in the minds of certain literary men is a fact which we are entirely at a loss to account for. We have had frequent occasion to give examples of this, but of late we have declined to expose the fallacies which have been advanced to support a foregone conclusion of the pernicious working of these protective laws. An attack from a new quarter compels us,

however, to draw attention once more to the character of the opposition with which inventors have to cope in maintaining their claims to legislative protection for their special industries, which claims are, as we think, reconcilable to reason, if on no other grounds at least (to use the words of an old legal authority) on this, viz., that "by the laws of God every man should live by his labour." A writer in the *Edinburgh Review* for April, 1865, commences an essay on the Patent Laws by referring to the debate which inaugurated the abolition of monopolies in the reign of James I.; his object being to show, that whereas, in the early part of the seventeenth century, the country groaned under the oppression of monopolies which had extended to well nigh every marketable commodity, and threatened even to extend to bread, our legislature, in this enlightened nineteenth century, by sanctioning the granting of patents, has wrought for us this last humiliation, and realized that "of which the mere imagination once provoked such wrath in Parliament;" for, proceeds the reviewer, "a man shall hardly mix flour and water, and bake them into bread in any manner which has not been granted by the Crown to the exclusive use of some patentee."

We have intimated that the literary opponents of the patent laws are actuated by enmity in the conduct of their opposition. Strange as this statement may appear, we find not only warrant for the assertion, but we are driven to the conclusion from sheer inability to find any other. In general, when a public man discusses a subject that is outside the arena of politics and theology, he reviews both sides of the question, and strives to show, by force of argument, that the way of his inclining is the more consonant with reason. Not so, however, is it with writers against the patent laws. We have in these pages cited many examples, but we never came across anything more rabid or unjust than the article now before us. It purports to review the blue book recently presented to Parliament by the Patent Law Commission, and to notice the evidence generally collected on the subject, yet not the slightest indication is given throughout the paper that evidence exists of the beneficial working of the principle of rewarding inventors by patent grants. The reviewer, in undertaking to demolish the dictum of Mr. J. S. Mill,—that the greater the usefulness of the invention, the greater the reward conferred by patents,—adopts the following line of argument, which shows at least that he has arrived at a pretty competent knowledge of the virtue of an "if:"—

"Where the market is open to every producer, if one man gets a better price than his rivals in trade get, it must be because he sells

better articles, and he can only sell things at a fair profit on their cost of production. But *if* he can exclude all rivals from the market; *if* he can seize the exclusive sale of things essential to production and improvement; *if* he can threaten a whole trade with litigation and penalties, his price is an exaction from necessity and fear; and the amount of his profit depends on the number of persons he can injure, the amount of injury he can do to them, and the amount of money they have in their possession. The blackmail a freebooter can extort does not depend on his usefulness to the community; it is paid, not for a good, but to escape a greater evil."

We commend this passage to the attention of Mr. Mill, with the assurance that if he is not satisfied of the "fallacy of the assumption that the profits of a monopoly are in proportion to the benefit which the monopolist confers upon the public," nothing which the reviewer can say further will convince him.

Our reviewer is a free trader, not, however, of the old school of thought—those timid men, who feared to give their principles full scope: he reaches far beyond Adam Smith and Jeremy Bentham, and their disciple, Mr. Mill; and, like some other great living political economists, who meet only with ridicule when they discuss the subject of monopolies at the meetings of the British Association, the Statistical Society, the Society of Arts, and elsewhere, he sees the very elements appropriated by monopolists, and his mind revolts at such injustice. It is contrary to nature. He has, doubtless, in his humility, stooped to learn from the bees—those monitors of childhood, as interpreted by Dr. Watts—another lesson than that enforced by the poetic divine, viz., that as drones claim equal rights with working bees in the honey derived from prolific nature, so, in the human economy, those who go forth to explore nature's secrets, must, on their return, be content to share alike their gathered treasures with the other inmates of the hive. Whether it is that this idea is new to the reviewer, and that, consequently, he has not had time to digest all the surrounding facts, we will not attempt to decide; but it certainly appears to us that he has, to some extent, contradicted himself in the following passages, which are set side by side, for better comparison. If it be so, he may be safely left to neutralise his own denunciations:—

The patentee claims sole dominion, not only over the forces or substances he specifies, but over any equivalent forces or substances which the realm of nature may afterwards be discovered to contain. A Mr. Dawber invented a

"A patent must cover equivalent modes of producing the result, otherwise it would be evaded. What, then, is an equivalent? This was one of the chief questions in Heath *v.* Unwin. Mr. Heath had obtained, in 1839, a patent

mode of purifying gas by the use of ochre found in certain bogs of Ireland. . . . . . This use of his discovery was challenged by Mr. Hills, as within his patent, and had that patent been prolonged by the Privy Council, as sought by Mr. Hills, we could not answer Mr. Dawber for the consequences. (p. 595.)

for the use of carburet of manganese in the manufacture of cast steel, but it was subsequently discovered, in his own manufactory, that the great advantages obtained by the use of the carburet might be obtained at much less expense by the use of its elements, coal tar and oxide of manganese. Protracted litigation ensued, involving several questions, both of law and fact, of which the chief were, whether the patent for the use of carburet of manganese covered the use of its elements? and whether the use of the elements was new at the time of the patent? 'It was quite clear,' said Baron Park, in giving his judgment, 'that the defendant Unwin never meant to use the carburet of manganese at all. There was therefore no intention to imitate the patented invention.' " (p. 592).

From the above it will be seen, that whatever a patentee may feel disposed to lay claim to, it is certainly not the law which gives him dominion over the forces which the realm of nature may be found to contain.

Another argument advanced against the patent laws will, we think, be best answered by the examples adduced by the reviewer himself, as if to contravene his own assertions :—

"It is said that inventors, and especially poor inventors, need protection—and it is true; but the legislature has mistaken the means of protection. They need protection from the multitude of restrictions, dangers, and exactions to which they are at present exposed. The atmosphere of invention is liberty—*liberty for every man to use all his powers and knowledge to try any method, to embark in any business, and to make any combination.*" (p. 597)

"Hargreaves obtained a patent for the spinning jenny, but it was infringed. *An association was formed against him, and he died in obscurity and distress.*

"Dr. Cartwright's patent for the power loom was prolonged for fourteen years, but he lost £30,000 by it, and was only rescued from great poverty by a parliamentary grant.

"If any man ever deserved a patent, it was Heath; and Heath was ruined by the patent he obtained." (p. 599)

Respecting the motives for and against invention, the reviewer says :—

"It is sad to have to tell professed free traders that unrestricted competition stimulates *every* producer to employ all the means in his power to get before his competitors, and forces him to do so in order not to be left behind by them." (p. 601)

"Patentees are even deterred from improving upon their own improvements.

"The patentee enters not in himself, and suffers not to enter those that would." (p. 603)

The practical good sense of our reviewer appears to revolt at the argument which is often employed—that protection is necessary to establish a new manufacture. He says on this point:—

"Does anyone suppose that no one would use a better machine or process already invented, and the use of which produced better or cheaper articles, unless he got a patent for doing so."

To this we reply by the following quotation from a recent number of the *American Artisan* :—

"Many years ago, Mr. Wm. B. Leonard sent on an assistant to Europe, to learn what improvements had come up in the shops, and in machinery for manufacturing textile fabrics. He brought back drawings of a mule, with reports of its performance, which were highly favourable. Mr. Leonard tried to get orders to build the mule, but could not get them, unless the complete success of the machine was guaranteed. Mr. Leonard represented that he could not be benefitted by incurring the risk of failure of the machine. Perhaps, from imperfect construction, and, perhaps, from inexperience in those who used it, if it failed, he would lose it, and, if it succeeded, he would have to build it as cheaply as others could, and, therefore, could make no extra profit to indemnify himself for the risk, and for the expense of sending his man abroad. The manufacturers replied that they were in nearly the same predicament. If they had one built, and it failed, they would lose by it, and, if it succeeded, their rivals would have others built like it, at shop prices. But they suggested to Mr. Leonard that he might get a patent, by Act of Congress, and offered to sign a petition for him if he would apply for a patent. He did so, and got a patent; and the mule came into use; and Mr. Leonard made a large amount of money by it."

We have thus far directed attention to the judgment and the knowledge displayed by our reviewer in matters relating to patent law. We must, however, before closing our remarks, briefly put his honesty to the test. We will not take exception to his facts, for he may be supposed to have had a right to choose them as he pleased, in order to support a foregone conclusion—although the policy of giving currency in a popular magazine to an attack on any received opinion, or established

system, framed on this principle, is, at least, questionable,—but we have a right to expect that they shall be honestly applied. In order to show how impossible it is for an inventor to learn what has preceded him, the reviewer adopts a plan which is worth the attention of Old Bailey practitioners. Quoting first a paragraph in Mr. Carpmael's evidence, referring to his practise of advising manufacturers to obtain printed copies of every specification relating to their particular business, he proceeds:—" How a poor man is to have such a library is not stated; but the following answer of another witness will throw some light upon the point:—

"'Vice-Chancellor Wood—What do you charge for such a specification as this, the drawings of which you have produced?—The price, £2. 13*s*., is marked upon the cover.'"

Now the only fair inference from this extract is, that £2. 13*s*. is an average or ordinary charge for a printed copy of a specification, and it can be for no other purpose than to convey this impression that it is thus given. Yet, will it be believed that reference is here made to a specification which, from its exceptional bulk, was selected by the Patent Office authorities to show the power of patentees to waste the funds of the office, in this case £423, by throwing upon it the duty of publishing unsaleable specifications, lengthened out with useless drawings. The reviewer might have acquainted himself with the fact, if he pleased, that the cost of printed specifications does not average more than 1*s*. Yet so eager was he to make out his case against the patent laws, that he could not resist the temptation to palm this false inference on his readers.

For the benefit of our reviewer and the advanced free traders who think with him, we commend the following extract, from a work enentitled, "The Progress of Machinery and Manufactures in Great Britain,"* to their attention:—

"It should be remembered that Coke, who drew up the Bill that the Lords discarded, had declared that 'he was against all new inventions and projects,' and that 'free trade was a great prejudice to the commonwealth.' From the whole tenor of his opposition to the patents (oppressive monopolies), as they were discussed *seriatim*, it might be inferred, with perfect fairness, that had the House been guided solely by his judgment, letters patent for inventions would have been abolished altogether."

* London: John Weale, 1846.

Recent Patents.

To Leonard Cooke, *of Horwich, Lancashire, for improvements in the manufacture of paper.*—[Dated 4th April, 1864.]

This invention is particularly applicable in the manufacture of paper for making paper hangings, but it may be applied in the production of paper for other purposes. The invention consists in applying the pulp, size, colouring matter, or other substances, of which paper is or may be composed, either separately or combined, at two or more times, or from two or more vessels, to the endless wire-gauze belt of the ordinary paper machine; care being taken that a portion of the moisture in the pulp, size, colouring matter, or other substance already deposited on the wire gauze be removed, in the usual manner, before the additional pulp, colour, size, or other substance or substances are added.

The figure in Plate XII. is an elevation of an ordinary paper machine, to which the improvements are applied. *a*, is the spout for conveying the pulp from the usual pulp chest to the strainer *b*; *c*, is the spout for conveying the pulp from the strainer *b*, to the delivering board with apron *d*, by which the pulp is spread on the endless wire gauze *e*, passing over the rollers f, f^1, f^2, and under and over the rollers g, g^2; *h*, is the deckle frame, with pulleys; and *i*, the deckle strap for regulating the width of the paper; *j*, *j*, are the vacuum pump or exhaust boxes; *k*, *k*, are the couch rolls, from which the paper is taken to the press rolls by an endless felt, and then to the drying cylinders. All the parts above enumerated are made in the usual manner, and form no part of the invention.

The improvements in the manufacture of paper consist in the application of one or more additional spouts, troughs, delivery trays, rollers, or their equivalents to the ordinary paper machine in the following or in any other convenient manner. *l*, represents a spout for conveying the pulp from a second pulp chest or strainer to the trough *m*, which is, or may be, furnished with two or more cross ribs, or any other convenient arrangement of parts, for the purpose of spreading evenly, and preventing the too rapid flow of the pulp. The point of delivery of the trough *m*, is above or beyond the first vacuum box *j*, and beyond this point of delivery is placed the slice *n*, to level the pulp, size, colouring matter, or other substances; or a roller may be applied instead of, or in addition to, the slice *n*. When the machine is at work, and it is desired to produce a compound paper with a good top and an inferior lower surface, the coarser pulp would be supplied to the wire gauze *e*, by the board and apron *d*. As the wire gauze is carried over the first vacuum box *j*, a portion of the moisture is removed from the coarser pulp before the finer pulp is deposited from the trough *m*, on to the coarser pulp; the two thicknesses of pulp then continue to move onwards, and pass over the second vacuum box *j*, by which the moisture is removed, and the compound paper, on arriving at the roller f^1, is sufficiently consolidated to be removed from the wire gauze *e*, and carried between the couch rollers *k*, in the usual manner. It is evident that when a compound paper is required with a fine surface on each side, and an intermediate portion made of an inferior material, two additional troughs and a corresponding number of vacuum boxes must

be applied to the paper machine. It may likewise be desirable to apply additional troughs, delivery trays, rollers, or their equivalents for supplying size, colouring matter, or other substance or substances to the paper; and by making the troughs by which colour is supplied, with slots or any other suitable arrangement of parts, for the passage of the colour, striped paper of one or more colours and qualities can be produced on the paper machine. Waved stripes may be produced by giving a lateral to-and-fro motion to the colour troughs by an excentric or other means; and other designs may be produced by means of rollers with patterns. By means of the improvements above described, compound paper is produced at one operation on the paper machine with a good top surface and an inferior lower surface, or *vice versâ*, or with a fine surface on each side and an inferior intermediate portion, or with the top and bottom surfaces of different qualities, colours, and designs, and with more or less size, colouring matter, or other substances applied at one or more times.

The patentee claims, "the application of pulp, size, colouring matter, or other substances at two or more times, or from two or more spouts or other equivalents, to the endless wire gauze belt of an ordinary paper machine, as shown and described; or to the endless wire gauge of any other machine, or combination of machinery, for making paper."

To WILLIAM EDWARD NEWTON, *of Chancery-lane, for improvements in mules for spinning,—being a communication.*—[Dated 16th May, 1864.]

IN ordinary self-acting mules for spinning, the mechanism hitherto employed for causing the carriage to move backward and forward has consisted of two cords or straps, one end of which has been attached to the carriage, and the other end to a piece of mechanism termed a scroll; and as the cords, and also the scrolls, sometimes vary in diameter, the strain on the cords, or the major part of the strain, when the carriage is moved in or out by the cords, is liable to come only on one cord or strap, thereby destroying it, or deranging the machine, in a short time.

The object of the present invention is to remedy this defect, by employing a single cord or strap, attached by its ends to the two scrolls, and passing such cord or strap round a loose pulley pivotted on the carriage, and thus, by the play given to the cord or strap by the pulley, the strain will be equalized throughout.

In Plate XI. fig. 1 is a sectional elevation of so much of a self-acting mule as is necessary to show the invention. *a, a,* is a single cord or strap, attached by its two ends to the scrolls *b, b,* and passing round the pulley *c,* which is mounted on the vertical spindle or axle *d,* in the carriage *e,* of the spinning frame.

It will be evident, from this arrangement, that the cord *a,* will be kept at the same tension throughout its entire length. Should the cord become slack, it may be tightened by drawing up the pulley *c,* by means of the screw *f*; for which purpose the spindle *d,* of the pulley *c,* is mounted in a block *g,* which is capable of moving between the guides *h, h,* when the screw *f,* is turned round.

Instead of a single cord *a*, which passes round a pulley *c*, as in fig. 1, this cord may be divided into two parts, and the divided ends may be attached to the arms of a rocking lever, which is mounted on a vertical spindle or axle, in place of the pulley *c*, of fig. 1; or the divided ends of the cord may be secured to a rocking arc or wheel. It will be evident that the equilibrium of the cord or cords may be maintained by various other mechanical arrangements, which will, however, be merely mechanical equivalents for those shown and described.

The patentee claims, "the mode, herein set forth, of equalizing the strain on the cord or strap which actuates the carriage of self-acting mules."

To ALFRED VINCENT NEWTON, *of Chancery-lane, for improved machinery for making horse-shoes,—being a communication.*—[Dated 8th June, 1864.]

IN Plate XI. fig. 1 shows, in front elevation, the improved machinery for making horse-shoes; fig. 2 is a transverse vertical section in the line ×, ×, fig. 1, looking towards the right hand; and fig. 3 is a similar section, looking towards the left hand. A, A, is the frame which carries the bearings for the rolls B, B¹. In the lower roll B, is sunk the counter die C, and a cam *a*, formed on its surface, serves to operate the cutter *b*, which is attached to a curved bar D, carrying a bowle at its lower end, in contact with the cam *a*. This bar D, has at its fulcrum a pin, projecting from the framing A, and in combination with the stationary cutter C, it causes the cutter *b*, to cut off the blanks to the required length. The swaging die E, is carried by the upper roll B¹. Two curved grooves *d*, *d*, at the sides of this die, and in the surface of the roll B¹, form the guides for the vibrating arms *e*, *e*, which hold the blank after the same has been cut, and bend it around the mould or shaping die F. In doing this it is necessary to allow the blank a certain amount of play, so that it can spread under the action of the swaging die; and if the iron is bent through the action of the front of the shaping mould or die itself, it will lie close up to the mould, or at least to the front of the mould, and no chance is left to the same to spread. In order to avoid this difficulty, the front *f*, of the mould is made moveable, and it is so arranged as to recede, and allow the iron to spread under the action of the swaging die E. The front *f*, is attached to an arbor *g*, that passes through the interior of the roll B¹. One end of this shaft extends beyond the end of the roll, and forms a crank *h*, which, by sweeping over a stationary cam *i*, on the side of the frame A, keeps the front *f*, up. A spring *j*, attached to the front *f*, and operating in the interior of the cylinder B¹, has a tendency to throw the front back as soon as the crank *h*, is released from the cam *i*. This cam is furnished with a shoulder *k*, in passing which the crank *h*, is suddenly released, allowing the front *f*, to recede through the action of the spring *j*; and the shoulder *k*, is in such a position that the front is thrown back just before the action of the swaging die on the blank begins.

By these means can be accomplished, in a simple and effective manner, what otherwise requires complicated machinery; and at the same time the front *f*, can be made to project far enough to afford a good hold on

the blanks without interfering with the action of the swaging die. After the horse-shoes have been completely formed by the action of the rolls B, B', they are taken up by the clearer H, from whence they are removed, and put away in any convenient receptacle.

The patentee claims, "constructing horse-shoe machinery in the manner and for the purpose described."

To WILLIAM EDWARD NEWTON, *of Chancery-lane, for improvements in the construction of pulley blocks and sheaves,—being a communication.*—[Dated 15th June, 1864.]

THE object of this invention is to prevent a large portion of the friction attending the use of pulley blocks as at present constructed, and at the same time to reduce the dimensions of a block of a given power very materially, while the smallest sheave of the same will admit of the rope bending or conforming to it perfectly without the liability of rupturing its outer fibres.

In Plate XII. fig. 1 is a section of one of the blocks; and fig 2 is a section of an excentric sheave, pertaining to the same, taken in the line *y*, *y*, (fig. 1). A, represents the cheeks of a pulley block, connected together at suitable distances apart by rods B, as usual, and carrying an axle F. On this axle the inventor arranges three sheaves,—one outer one being keyed to the axle F, the middle one being placed loosely, but concentrically, upon it, and the outer one being placed excentrically upon the axle. The concentric sheaves require no particular description, but the excentric sheave, being constructed and applied in a novel way, and forming the gist of the invention, will be described minutely. *a*, represents a hub, provided at one side with a flange *b*, which may be cast with it. Another flange *c*, is made separately, and secured to the other side of the hub by screws *d*. The hub *a*, has a hole *e*, made centrally through it for the axle F, to pass through. The edges of this hole are rounded off, so as to permit of the sheave maintaining a steady bearing in corresponding grooves in the axle, and the hole is made twice the diameter of the axle. In the space or groove formed by the two flanges *b*, *c*, there are placed a number of friction rollers *f*, which are encompassed by a ring *g*, the outer surface of the latter being grooved circumferentially to receive the rope G, of the block. This rope is attached to the upper block, and passes around the several sheaves of the two blocks. Both blocks are constructed precisely alike, and the rope G, is arranged or applied in the usual way.

From the above description it will be seen that the excentric position of the sheave E, is due to the increased diameter of the hole *e*, in the hub *a*, over the diameter of the axle F; and this excentricity virtually diminishes the diameter of the sheave to a degree equal to its excentricity.

The patentee claims, "the employment or use, in a pulley block, of one or more excentric sheaves in connection with the ordinary concentric sheaves, one or more arranged to operate in the manner, and for the purpose, set forth."

To William Henry James, *of the Old Kent-road, for improvements in steam and air engines.*—[Dated 10th June, 1864.]

This invention relates to the construction and mode of working engines by the expansive force of highly-compressed air in conjunction with that of steam of still greater pressure, the compressed air being produced and heated, and the high-pressure steam introduced therein, during each and every revolution of the engines. These engines are very similar in appearance, and in their mechanical arrangements and mode of action, to those of open-topped cylinder single-stroke steam engines, any number of which, by combination, may be made to operate upon one main shaft, so as to constitute engines of any required power.

In Plate XI. an engine constructed according to this invention is shown in sectional plan view. *a, a,* are two open-topped cylinders; *b, b,* are cranks of sufficient throw to allow of the pistons *c, c,* protruding beyond the mouths *d, d,* of the open-topped cylinders *a, a,* with the object of allowing the escape of the air and steam into the atmosphere through small apertures *e, e, e, e,* formed in other cylinders, *f, f,* which are accurately and firmly attached to the first-mentioned cylinders *a, a,* by means of flanges and bolts *g, g, g, g.* These perforated cylinders serve as guides to the pistons *c, c,* when they travel beyond the mouths of the cylinders *a, a*; or the cylinders *f, f,* may, if preferred, be formed in single castings with the cylinders *a, a,* so as to constitute two long cylinders only, and the series of small apertures, or exit passages, may be afterwards formed in them by drilling or otherwise. The areas of these apertures should, combined, be as great, or greater, than the cross sectional area of the cylinders, so as to allow abundance of space, not only for the escape of the air and steam after having actuated the pistons *c, c,* but also for admitting fresh atmospheric air into the cylinders *a, a,* wherein it undergoes compression by the return strokes of the pistons *c, c,* into chambers *h, h,* in the bottom of the cylinders *a, a,* beyond the movement of the pistons. When the pistons reach the bottom of their stroke, they come in contact with the spindles of valves *i, i,* seated in the chambers *h, h.* These valves are for the purpose of admitting high-pressure steam, conveyed by pipes *k, k,* thereto from any boilers or generators into the air compressed into the chambers *h, h,* for heating the same and, by the joint expansive force of the steam and air, actuating the pistons *c, c,* of the engine, or a single piston when a single cylinder engine only is employed. Strong spiral springs are attached to the spindles of the valves *i, i,* for keeping them firm in their seats, and for preventing the compressed air passing by them into the boiler (unless under an excess of pressure), or steam passing through them until struck and opened by the pistons, as before stated. The noise arising from the air and steam escaping under pressure into the atmosphere, may be almost entirely prevented by attaching stop-cocks or valves *l, l,* to the bottoms of the chambers *h, h,* which cocks may be kept open during any portion of the descent or return strokes of the pistons, so as to diminish as required the quantity of air to be compressed, and, consequently, in a proportionate ratio, the pressure and noise during its escape. These cocks may likewise be used for admitting fresh air into the cylinders, in addition to the other means em-

ployed for that purpose; proper mechanical appliances being used for regulating the motion of the cocks in connection and unison with that of the engine itself. Stop-cocks or slide valves may be used, if preferred, instead of the valves *i*, *i*, before described, for introducing the steam into the compressed air at every revolution of the engines, by means of excentrics, tappets, or cams, fixed upon the main shafts of the engines, for communicating the requisite motions to such cocks or valves by connecting rods.

The patentee claims, "constructing engines, to be worked by air and steam combined, in the manner described."

To WILLIAM FREDERICK THOMAS, *of Newgate-street, for improvements in sewing machines.*—[Dated 27th June, 1864.]

THIS invention relates to the means of giving motion to the shuttle of sewing machines. The rod which carries and works the shuttle driver, in place of being caused to slide as heretofore in bearings, is at that end of it on to which the shuttle driver is fixed, caused to rest and slide on a guide rail, and, at its opposite end, which is most distant from the shuttle driver, it is suspended from an axle by a link or lever. The rod, as heretofore, is actuated by a face cam.

In Plate XI. fig. 1 shows a side view of the frame of a sewing machine, together with so much of the working parts of the machine as give motion to the shuttle. Fig. 2 shows a plan view of the shuttle race, and of the shuttle and shuttle driver. *a*, is the shuttle driver, constructed in the ordinary manner; and *b*, the rod which carries and gives motion to the shuttle driver. The end of this rod to which the shuttle driver is attached, rests on the top of the back *c*, of the shuttle race, which forms a guide rail for it. The opposite end of the rod *b*, in place of being supported in a groove or guide, as usual, is supported by the pin *d*, on the lower end of a link, *e*. This link, at its upper end, has a pin *f*, projecting from it, which works in a hole bored to receive it in the upper part of the frame of the machine, and upon this pin the link is capable of turning. On the outer end of the pin *d*, is a roller *g*, which works in the groove of the face cam *h*, that turns on the axle *i*; the other cams carried by the axle *i*, for actuating the lever that works the needle, and the foot that gives motion to the work, are not shown, as their construction is well understood. The end of the rod *b*, and the roller *g*, which transmits motion to it, from the cam being suspended as above described, the rod moves with less friction than heretofore, and receives a more even motion from the cam. The noise made by the machine in working is also thereby lessened.

To FREDERICK LUDEWIG HAHN DANCHELL, *of Red Lion-square, for certain improvements in apparatus by means of which air, gas, or vapour is to be removed from tubes, pipes, tunnels, pans, retorts, or other vessels.*—[Dated 1st July, 1864.]

THIS invention consists in applying jets of steam, which are conducted into a series of tubes connected with an air or gas holder intended to

be exhausted, whilst the other ends are left open to the atmosphere, or to a vessel or vessels into which the air, gas, or vapour thus exhausted is required to be conducted. The relative size of the orifice of the jet pipes and the tubes, together with the pressure of steam, forms the condition for the greater or less exhaustion, or greater or less current thus produced, that is to say, the less the difference between the size of the tube and orifice, and the greater the pressure of the steam issuing from the orifice, the greater is the effect produced.

In Plate XI. is a vertical section of the improved apparatus. *a*, *a*, is a tube, in connection with a vessel, from whence air, gas, or steam is to be removed, or in which a current is to be produced; *b*, is a pipe, through which the steam passes from the generator to the pipe *c*. The effect produced by the steam blowing off through the pipe *c*, is that of removing the air from the upper part of the tube *a*, at a^1, and thus producing a vacuum, or partial vacuum. The air, gas, or steam from the lower part of the tube *a*, is constantly filling up the exhausted space a^1, until the equilibrium between the atmospheric pressure acted on by the jet and expansion of the rarified air, gas, or steam contained in a closed vessel is established. If, however, the vessel is not closed, air will pass into the vessel at the same ratio as it is drawn out by the jet, and thus a current is produced to remove either vapour or gases, or to put objects in motion, such as carriages, waggons, or carts, in tunnels or tubes.

The patentee claims, "the above arrangement to exhaust closed vessels, or to produce currents or motion in open vessels."

To William Lloyd, *of Dartmouth-street, Westminster, for improvements in the manufacture of hydro-carbon gas, and in apparatus employed therein,—being a communication.*—[Dated 5th July, 1864.]

This invention consists in the introduction of dry steam to the retorts containing the coal or other substance heated to their own intensity, and in preventing any reduction of the temperature during the process of making the gas, all as hereafter explained.

In Plate XI. fig. 1 is a front elevation, and fig. 2 a longitudinal section, of a pair of gas retorts, arranged suitably for carrying out this invention. A, A, are the two retorts; B, B, are plates or false bottoms, in each retort, with side ribs, and a central rib, resting on the bottom of the retorts. The plates B, B, are thus raised about one inch and a half from the bottom; but the central rib also serves to divide the space contained between each plate B, and the bottom of the retort into two longitudinal channels. E, is a steam pipe, for conveying steam from a boiler or other supply. This pipe has branches F, F, leading to each retort, furnished with cocks G, G, for governing the admission of the steam. The retorts A, A, are charged alternately, and the steam is admitted into the retort in which the charge is most incandescent. The steam first enters one of the channels between the plate B, and the bottom of the retort, proceeds along that channel, enters the other channel by a communication H, at the back end, where it is superheated to the same degree of temperature as the retort. The superheated steam emerges from the front end of the second channel into

the incandescent charge in the retort, through which it is compelled to travel, becoming thoroughly decomposed by the red-hot coke; it then enters the second retort by a back connection I; this retort is charged with coal in a bituminous state, and the steam takes up the proper equivalent of carbon to convert it into illuminating gas; it then escapes by the ascension pipe J, to the main. K, K, are valves in the ascension pipes J, J; these valves are connected by a lever L, so that the closing of the one opens the other. M, is a valve in the back connection I, to facilitate the charging.

The patentee claims, "First,—introducing dry steam to the retorts containing the coal or other substance heated to their own intensity, and preventing any reduction of the temperature during the process of making the gas as described. Second,—constructing retorts for the manufacture of gas, substantially as described."

To DAVID BLAKE, *of Manchester, for certain improvements in steam fire engines,—being a communication.*—[Dated 5th July, 1864.]

THIS invention consists in the combination of a steam cylinder containing two pistons with a water cylinder containing two pistons, the said steam pistons being moved to and from each other by the steam entering by valves alternately between them and at each end. The steam pistons are severally connected to a water piston by piston rods, one working within the other. By this description of pump, and its combination with the engine acting as described, a continuous discharge of water is obtained, and great force and power is given to the water ejected, and great regularity and uniformity in the working and freedom from shaking is obtained.

In Plate XI. fig. 1 is a vertical longitudinal section of the improved engine; and fig. 2 a section of the valve and detached part of the cylinder having the steam ports. a, a, is a frame, secured to the boiler, and upon it the steam cylinder c, and the water cylinder d, are mounted. These cylinders have each two pistons e, f, and g, h. The pistons f, and g, are secured to a hollow piston rod i, and the pistons e, and h, to the rod j, which works within the hollow rod i. The shaft a^1, is mounted in bearings b^1, b^1, and carries at each end balance wheels k. Between the bearings are two cranks, to one of which is connected the piston rod j, by means of the connecting rod l; and in the balance wheels are placed cranked pins, to which are attached the connecting rods, for working the cross head m^1, which is secured to the hollow piston rod i. The valve n, is worked by means of a crank or excentric on the shaft a^1, connected with an arm upon the rocking shaft g^1, and the valve rod h^1, is connected to the rocking shaft by means of the arm i^1. The steam is admitted at the end of the cylinder through the ports j^1, j^1, when the valve is in position, as in fig. 1,—forcing the steam pistons to the centre, and the water pistons to the ends of their respective cylinders, the steam exhausting through the ports l^1, k^1; and as the valve is changed the steam is admitted to the centre port l^1, and the several pistons are forced in opposite directions. To accomplish these results the valve is peculiarly constructed so as only to require a single valve to operate the two pistons, the opening m^1, admitting steam to the

port j^1, and having a chamber n, through which the steam exhausts through the port k^1, when in position, as in fig. 2; and at the opposite end by way of the chamber o, and the port k^1; at the same time admitting steam to the centre through the opening p, in the valve and port l^1, and thus alternately working the tables as desired.

The patentee claims, "First,—the combination of two pistons, moving in opposite directions at the same time, in one steam cylinder, operating two pistons in one water cylinder (in opposite directions) connected by two piston rods, one working within the other, the motions of which are governed by a double crank, or other equivalent, having direct connection with the piston rods, substantially in the manner and for the purpose described. Secondly,—the construction of the single valve having openings and chambers for the admission and exhaustion of the steam at the ends and centre of the cylinder, so constructed that both pistons are operated upon in opposite directions at the same moment, as described."

To EDWARD CLIFTON, *of Bradford, Yorkshire, for improvements in brushes, and in the manner of applying them to machinery for combing wool, cotton, silk, or other fibrous substances.*—[Dated 5th July, 1864.]

THIS invention relates to the dabbing brushes employed in wool-combing machines for pressing the wool or other fibre into the teeth of the combs, and the object of it is to reduce the great wear and tear in such brushes produced by the constant striking on the teeth of the combs at the same place or part of the brush, and thereby soon wearing out the bristles at those places, whilst the bristles at other parts are not injured, or but slightly so.

In Plate XI. fig. 1 is a vertical section of a dabbing brush, with parts of apparatus in connection therewith, constructed according to this invention; and fig. 2 is a plan of the same. a, is a circular brush, mounted centrally on a pivot bolt b, which passes through it and through a bush c, attached to the ordinary slide arm d, to which arm reciprocatory motion is given in the usual manner. The dotted lines e, and f, show the several rows or lines of teeth of two circular combs of combing machinery, known as "Noble's machine," for which this invention is especially adapted, and the arrow indicates the direction of motion thereof. The pivot b, is placed within the lines of teeth, so that as the combs revolve or move forward, the brush is also caused to rotate slowly, or move forward, intermittently, in the same direction; by which it will readily be seen that the brush is constantly changing its position, or varying the points of contact with the teeth of the combs at each stroke, so that every part of the brush is brought into action. To render this rotation of the dabbing brush regular, and capable of adjustment as to its speed of rotation, a worm wheel g, is fixed on the back of the brush, gearing into a worm h, which is fixed on a spindle mounted on a bracket i, of the slide arm; and a ratchet wheel j, is fixed on this spindle, having a spring catch k, taking into the teeth thereof. Another catch l, is hinged in the end of a rod or arm m, which is capable of being set and held in a bracket n, fixed into the ordinary pillar p, of the machine to which the brackets for the slide arm d, are

fixed. When the slide arm moves upwards, this catch *l*, will act upon the teeth of the ratchet wheel, and turn the worm, and consequently the brush, and the spring catch *k*, taking into the teeth of the ratchet, will prevent its turning backwards. The rod *m*, can be set in the bracket higher or lower, to act more or less upon the teeth of the ratchet, or to move it in the space of one, two, or more teeth at a stroke, as is found most desirable. *r*, is a small additional brush, fixed to the slide arm, which is found useful in striking the wool partially into the teeth of the combs before the rotating brush comes into action. Or, instead of a circular rotating brush, it will be evident that an ordinary form of brush, or other forms, may be caused to oscillate, or traverse, or move to and fro laterally by means of a crank or excentric applied to any convenient rotary part of the machine, and a rod connecting the same to the brush so as to cause the said brush to change place, or vary the points of contact thereof with the teeth of the combs at each stroke. Or, a brush may be employed in form of a travelling endless belt, but the circular form of brush, moved in manner shown, is preferred.

The patentee claims, "the giving rotatory, oscillatory, traverse, or other lateral motion to the dabbing brushes of combing machines, for the purpose of varying or changing the points of contact of the bristles of the brushes with the teeth of the combs."

To BENJAMIN FRANKLIN STURTEVANT, *of Suffolk, State of Massachusetts, U.S.A., for improvements in the mode of uniting pieces of leather, and in the manufacture of shoes and boots.*—[Dated 6th July, 1864.]

THIS invention consists in connecting leather and other materials by a line of sewing, composed of a series of loops or stitches, and a series of pegs or their equivalents; the pegs and the loops or stitches co-operating, so as not only to fasten together the pieces or sheets of leather or material, but mutually to aid in keeping each other in place therein.

The invention further consists in a new or improved manufacture of boot or shoe, viz., one which, besides its upper leather and sole or soles and a thread for connecting them together, has a row of pegs so combined and arranged therewith as not only to aid in fastening the stitches or loops of the thread in place, but to operate as an additional means of connecting the parts, and thereby improving the shoe in various respects.

In Plate XII. fig. 1 is a plan view of the improved mode of uniting the outer and inner sole of a boot together; and fig. 2 is a side elevation of the same. A, is the outer sole; B, the upper leather; and C, the "in-sole" of a shoe, they being connected by a thread *a*, and a series of pegs *b*, *b*, *b*, inserted within a series of awl holes.

The thread is to be looped within the awl holes, or it may be passed through them, and is to have a peg, either of wood or other proper material, driven into each hole, so as to either compress or expand the thread within the hole, and against its side or sides, in manner to not only firmly fix or aid in fixing the thread in the hole, but at the same time to firmly fasten the peg therein.

In sewing leather by means of a sewing machine, and with a thread (whether waxed or not), by running it through or looping it into a series of awl holes made in such leather, the part of the thread deposited within each hole will seldom completely fill the hole, in consequence of which, when the exposed parts of the thread may become worn out, the materials connected together are liable to be easily ripped apart. By means, however, of the row of pegs, the thread can be so firmly fastened within the several awl holes as to securely connect the parts together, and materially to prevent them from being ripped apart. The thread also serves to keep the pegs in place within the holes. The making of the awl holes, and the insertion of the pegs and the thread therein, may be effected either by manual labour and proper tools or implements, or such may be accomplished by mechanism operating automatically either in whole or in part.

The patentee claims "the new or improved art or mode, substantially as described, of uniting pieces of leather or other material. Also, the new or improved manufacture, or shoe or boot, made substantially in manner as described."

To Zephaniah Bridgewater Smith, *of Dudley, Worcestershire, and* John Richards, *of Tipton, Staffordshire, for improvements in railway chairs.*—[Dated 12th July, 1864.]

According to this invention, railway chairs are made of two pieces of wrought iron, cut from bars rolled of such a figure that when placed on either side of the rail their upper parts fit the body and base of the rail. Each of the pieces is furnished with a flange at its base, one end of each flange passing under the rail. By means of pins each half of the chair is fixed to the sleeper, and the rail secured between the two halves. The bars of wrought iron, from which the halves of the chair are cut by sawing or dividing the said bars transversely, consist of a broad flat plate, near the middle of which is a vertical, or nearly vertical, rib. One side of the rib is hollowed out at its base, so as to make it fit the side of the rail it is to be used with; the other side thickens towards the base, for the purpose of giving it strength.

Railway chairs made according to this invention are lighter and stronger than ordinary railway chairs; they can be put down and replaced more readily than the ordinary railway chairs, and are not liable to break.

In Plate XII. fig. 1 represents, in end elevation, and fig. 2 in plan, a wrought-iron railway chair, constructed according to this invention, supporting a portion of a rail. The chair consists of two pieces or halves *a*, *b*, situated on either side of, and under, the rail *c*. Each half, *a*, *b*, consists of a broad flat flange or base a^2, b^2, having at one side a vertical, or nearly vertical, rib or cheek a^3, b^3. The inner face of each rib or cheek is hollowed out at a^4, b^4, the hollowed part having a figure the reverse of that of the base or head of the rail; the inner face of the cheek or rib is thereby made accurately to fit the body and base of the rail, as best seen in fig. 1. The outer side of the rib is inclined towards the flange a^2, b^2. When the two halves *a*, *b*, of the chair are closed upon the rail *c*, they grasp it so tightly that the wooden

wedges ordinarily used to fix the rail in the chair are not required. Each end of the flange a^2, b^2, of the halves of the chair is provided with a hole, through which fastening pins d, d^2, are passed, for fixing the halves of the chair to the sleeper e. The fastening pin d^2, on the side of the flange opposite to that at which the vertical rib a^3, b^3, is situated, has a long conical head, and is made to bear against the base or lower head of the rail c, and assist in supporting the rail in the chair; the rail is thereby held at opposite points by each half of the chair.

In making the half chairs, bars of wrought iron are rolled to a figure in cross section, best seen in the end elevation of the half chair marked a, in fig. 1; and the bars are divided transversely into a series of the half chairs, having the width seen in fig. 2, or of any other width, as occasion may require. After making the pin holes at the ends of the base or flange of the half chairs, they are then ready for use.

The grooves in the rolls employed for manufacturing the bars from which the halves of the chair are cut, by sawing or dividing the bars transversely, have the figures proper to roll the said bars.

The patentees claim, "making each of the said chairs of two half chairs, or pieces of wrought iron cut transversely from rolled bars, consisting of a horizontal base or flange and a vertical, or nearly vertical, cheek or rib; the rail being supported upon the base or flange of each of the halves of the chair, and grasped and held firmly between the two ribs or cheeks of the halves of the chair, essentially in the manner described and illustrated."

To Saint John Vincent Day, *of Glasgow, for improvements in wheels and axle boxes for locomotive engines, carriages, and other vehicles used on railways, tramways, and common roads,—being a communication.*— [Dated 12th July, 1864.]

Wheels, constructed according to this invention, consist of two central bosses of cast, wrought, or malleable iron or steel, forming the nave, through which a hole is bored for receiving the axle. The interior faces of the two bosses are made flat or curved, and are kept at such a distance apart as to hold between them two thin annular plates of iron, steel, or other suitable material. The space between the plates increases gradually as the periphery of the wheel is approached, where the opening is of sufficient width to allow of the passage of the tyre between the two plates. The extremities of these two plates are rounded off, so as to form an annular, curved, or other shaped ring all round the plate on its inner or outer sides, and the back portion of the tyre is made of a counterpart form, with a raised ring all round it, fitting into the annular space on the interior of the plates. The central bosses and plates are bolted together, the result being a light and exceedingly strong wheel.

The figure in Plate XII. is a section of the improved wheel taken horizontally in a transverse direction through its axis. a, a, are the bosses, made of cast or wrought iron; their inner faces are faced, so as to be parallel to one another when put in position upon the wheel axle. Through these bosses a, several holes are formed, for the reception of

the rivets *b*, which pass through the bosses and through corresponding holes in the disc plate *c*, forming the body of the wheel. *d*, is the tyre, made of cast iron, which, owing to this system of construction, is capable of being cast in a chill in a state fit for use. The wheel is capable of many variations of form; instead of using the disc plates of the form shown, they may be corrugated either annularly or radially, so as to obtain a greater amount of elasticity. The space *e*, between the plates *c*, is filled with sawdust or other material, which is a low conductor of sound. The advantages resulting from this form and construction of wheel are—great lightness, combined with great strength; the preservation of the tyre in a solid state, that is, free from either bolt or rivet holes; and a great reduction of the noise usually resulting from the rolling of the wheels upon a line of railway, on tramways, or on common roads; whilst another advantage resulting is the prevention of accidents now frequently caused by the fracture of the tyres of wheels; and if the tyres should happen to get broken, the pieces cannot leave the wheel, on account of the powerful grip which the plates have on the tyre, whether whole or fractured.

The patentee claims, "First,—the general arrangement and mode of constructing wheels substantially as described. Second,—the application of elastic sides or discs for the purpose of holding the tyres of wheels, substantially as described."

To GURDON WADSWORTH PITCHER, *of Cullum-street, City, for an improved self-adjusting pipe wrench,—being a communication.*—[Dated 13th July, 1864.]

THIS invention consists in constructing a wrench in such a manner that it will accommodate itself to several sizes of pipe without being adjusted, while the instrument is inexpensive, durable, and of a most convenient form.

In Plate XII. is a longitudinal section of the improved wrench. The body A, and the handle B, of this wrench may be advantageously constructed of wrought or malleable iron. The handle B, is cheaply and advantageously constructed of a piece of iron pipe. The excentric C, is best made of tempered steel, and the minor parts may be formed of any suitable material. The body A, is curved to form one jaw for holding the pipe. For a second jaw a toothed or serrated excentric C, is employed, which works in a slot D, on an axle *a*, permanently fixed in the ears on the body of the wrench at either side of the slot. The excentric C, has teeth formed upon a portion of its periphery, and, for convenience, is provided with stops *b*, to prevent it coming in immediate contact with the jaw formed on the body A. The excentric C, is also provided with a circular handle *c*, for drawing back the excentric from the curved end of the body A, sufficiently to freely admit the pipe or other round piece of metal on which it may be desired to operate. The upper or serrated part of the excentric C, forming one jaw, is drawn towards the curved end of the body A, forming the other jaw, by means of a chain E, fixed at one end by means of a pin *d*, to the excentric C, and at the other to a rod F; or in any other convenient and suitable manner. This rod formed with a boss or washer *e*, on one end, extends partially through the body A, and the handle B, the said handle being hollow for this

purpose, as well as for the purpose of combining strength with lightness in its construction. The handle B, is open at the end adjacent to the body A, and closed at the opposite end. A spiral spring G, is wound round the rod F, one end of which spring is fastened to the said rod by means of a pin *f*, or may act against a boss formed on the end at the same point, and the opposite end acts against the shoulders *g*, formed on the interior of the body A. The handle B, is screwed into the body A, so that it may be easily detached and replaced when required. The excentric C, forming one jaw, having been withdrawn from the curved portion of the body A, forming the other jaw, sufficiently to admit the pipe or other article, the spring G, acting upon the rod F, to which the chain E, is attached, draws back the lower part of the excentric C, and forces the upper or serrated portion towards the curved end of the body A, thereby holding the pipe, or other article, securely between the jaws. The jaw or excentric C, is so arranged with reference to the curved part of the body A, and operated, that the pipe placed between the two jaws is immoveably held by the wrench, however much pressure may be applied to the handle B.

The patentee claims, "in combination, with the body A, the hollow handle B, the excentric C, the spring G, the chain E, and the rod F, constructed and arranged substantially in the manner, and for the purpose, set forth."

To JAMES GARTH MARSHALL, *of Leeds, for improvements in steam generators.*—[Dated 13th June, 1864.]

THE object of this invention is to produce a perfect circulation of the water in the steam boiler or generator, so that the steam, immediately it is generated, may escape from the surrounding water, and reach the steam space above. By a proper circulation of the water the colder portions thereof will be brought into contact with the hollow parts of the steam generator exposed to the fire or heated gases, and steam will be more rapidly generated than in boilers of the ordinary construction.

In Plate XI. fig. 1 is a side elevation, representing one of the improved modes of constructing steam generators. In this instance the boiler consists of a series of syphon tubes, secured in any suitable manner in a horizontal plate. Any convenient number of tubes, according to the capacity of which it is desired to make the boiler, may be used, and these tubes are converted into separate syphons, that is, the tubes are bent, and are made with legs of different lengths, the open end of one leg *a*, being made to communicate with the lower part of the boiler A, while the open end of the other leg a^1, communicates with the steam space, or with a higher level of the boiler. The bent parts of the tubes pass through the tube plate *b*, which forms the lower part of the boiler, and they project downwards into the fire space of the furnace B, and are thus subjected to great heat. By reason of the difference in the length of the legs a, a^1, of the syphon tubes, and the consequent difference in the level of the two open ends of the syphon tube, a rapid circulation of the water is maintained, as the cooler particles of water will pass down the shorter leg of the syphon, while the steam will rise up the longer leg.

Fig. 2 is a vertical section, representing another method of effecting the object of this invention. In this instance, instead of the bent syphon tubes a series of single straight vertical tubes c, c^1, are used, which are divided down the centre by a partition d, into two channels c, and c^1, both of which are open at the upper end, but at different levels. The two channels c, and c^1, communicate at their lower parts under the partition d, so that there will be an upward and downward current on opposite sides of the central partition, as indicated by the arrows. These vertical tubes project down from the tube plate B, at the lower part of the boiler into the fire space, precisely as the syphon tubes above mentioned. In order to cause the particles of steam, as they are formed, to pass up the proper channel, as indicated by the arrows, the lower end of the diaphragm or partition d, should be bent on one side, as shown at 1. This will generally be found sufficient to direct the steam into the proper channel, and this may be still further ensured by making transverse openings in the partition, and adapting thereto deflecting plates, as at 2, 2.

In constructing boilers with these divided tubes, it will be found advisable to arrange the several rows of tubes in such a manner that the descending channels of two neighbouring tubes should be opposite to each other, and the ascending channels of the tubes shall be opposite to ascending channels of other tubes, as seen best in fig. 3, which is a sectional plan view of a square upright boiler, constructed according to this invention. It will be seen that the fire-place C, is surrounded by a water space D, which is divided by a vertical partition d^1, into two channels, for ascending and descending currents, precisely as in the tubes, the partition d^1, being also divided with lateral openings at its lower part, and deflecting plates, to direct the steam into the ascending channel: E, is the fire door of the furnace, and F, the exit flue, communicating with a flue which surrounds the boiler, and into which the gases, after they have circulated among the tubes a, a, pass. The feed water may be supplied to the narrow water space surrounding the boiler, or to any other convenient part of the apparatus; or some tubes connected with the boiler may be placed in the flue, in order to intercept any heat that may have a tendency to pass off in that direction; and the feed water may, if desired, be made to pass through such tubes before it enters the body of the boiler.

Fig. 4 is a sectional view, representing a modification of the plan just described. In this instance, instead of tubes divided by a central partition, long narrow chambers or leaves are employed, which, however, are divided by means of a central partition d, as in the tubes of fig. 2, into two channels—an ascending and a descending one. It will be seen that, in all the several modifications, the ascending channel is carried up a considerable distance above the open end of the descending channel, and therefore the issue of the steam from the open end of the ascending channel will not disturb the water about the open end of the descending channel.

The patentee claims, "the mode herein set forth of producing a circulation of the water in steam boilers, so that the steam, immediately it is generated, may at once escape from the surrounding water, and reach the steam space above."

To Ephraim Ratcliffe *and* Christopher Ainsworth, *both of Over Darwen, Lancashire, for improvements in looms for weaving.*—[Dated 6th July, 1864.]

This invention consists in constructing the treadles of looms of two parts with a double boss, one boss carrying the treadle, and the other boss having a short arm cast thereto, in which arm, and in the treadle, is a slot hole and bolt. On the inner face of the boss carrying the treadle, and on the inner face of the boss of the arm, are a number of indentations and teeth, so that the two may, by means of the bolt, be securely held together. The boss and arm work on a stud fixed to a cross rail; the treadle may, by means of the bolt, indentations, and teeth, be readily fixed to the said arm at any angle, by which means the treadles are greatly shortened, and different lifts, with one and the same tappet or sets of tappets, are obtained, and thus the shedding is regulated as desired.

In Plate XII. fig. 1 shows the improved treadles and part of the cross rail; and fig. 2 is an end view of one of the improved treadles. *b*, is a cross rail, to which the treadles c, c^1, are attached by and work on the stud c: to each of the treadles c, c^1, is attached an upright piece d, in the upper part of which is a recess, in which, and on the pin or stud d^*, works the antifriction pulley e: the tappets f, f^1, at each revolution of the tappet shaft f^2, act on the antifriction pulleys e, e, (by means of the upright pieces d, d^1, which are secured to the treadles by the bolts g, g^1, and the teeth and indentations shown at h, fig. 2), and impart the necessary motion to the treadles c, c^1, which motion, by means of the "lam" rods j, j, the healds are actuated as required.

Treadles constructed as above described, are much lighter, and require proportionately less power to actuate them, than the ordinary treadles, which extend in length the width of the loom; and they may readily be set by altering the relative angles of the treadles c, c^1, and the upright pieces d, d^1, by means of the bolts g, g^1, and the slot hole i, so that the treadles may make a shorter or longer stroke actuating the lam rods and healds in proportion, thus regulating the shed.

The patentees claim, "the construction and arrangement of treadles, as herein set forth."

To Charles Hastings Collette, *of Lincoln's-inn-fields, for improvements in washing machines,—being a communication.*—[Dated 8th July, 1864.]

This invention relates to improvements on a washing machine, for which a patent was granted to J. H. Johnson, dated 17th October, 1863. The principal improvements consist in dispensing with the upper portion of the supports of the driving gear of the machine and drum.

The figure in Plate XII. represents a sectional elevation of the improved washing machine. A, is the vessel containing the washing fluid; B, the main framing, which supports the entire driving gear of the machine, as well as the vessel A. The various moving parts may be actuated by a crank handle on the axis l, or by a driving pulley. This shaft l, carries a drum E, which, by turning the handle, is made to

revolve. The shaft is supported by bearings *b*, of the framework B. The vessel A, which contains the washing liquid, is also fitted internally with a series of wood or galvanized iron rollers $c, c^{1}, c^{11}, c^{111}$, fixed on shafts supported by the framing B, as at *d*, *d*, so that these rollers may revolve when the strap or band I, imparts motion to them. There are other rollers, placed in the position of D, D^{1}, also fixed to the frame B, and which revolve on their own axes. G, is another drum, which revolves on a fixed shaft, supported by the arm or lever F, at *g*. The arm or lever F, is made so as to move on the bearing or pivot *f*, on the arm h^{1}, being part of the frame B. At the lower end of this arm there is at *h*, a spiral or other spring, for giving elasticity. It is at one end fixed on the frame B, as at *h*, and at the other end to the arm or lever F, at h^{1}, by which means the drum G, is kept pressed upwards (the arm F, working on a pivot at *f*,) and a proper and continuous tension is thus given to the band I. The driving band passes over the drum E, and under the rollers D^{1}, and D, inside of the vessel A, and will pass out over the drum G, and pass into the liquid again under the rollers $c, c^{1}, c^{11}, c^{111}$. On rotating the crank handle, the shaft *l*, and drum E, will receive the same movement, and will impart a rotatory motion to the band, which in turn will impart a rotatory motion to the rollers D^{1}, D, the drum G, and the cylinders or rollers $c, c^{1}, c^{11}, c^{111}$. The fabrics to be washed being thrown into the washing vessel on to the top of the rollers, are drawn by the rotatory motion of the rollers between them and the endless band I, and as the several rollers revolve at the same speed there is no danger of the articles becoming torn or injured. The fabrics move constantly over the rollers, passing alternately above and below them, and are compressed between the endless band and the under sides of the rollers, and carried through the water or washing fluid, which thus removes all impurities therefrom. The endless band will be kept at its full tension in consequence of the spring H, keeping down the lower end of the lever or arm F. The axles on which the rollers $c, c^{1}, c^{11}, c^{111}$, and rollers D, and D^{1}, revolve will be constructed with proper bushings, so as to prevent a leakage of the washing fluid. A tap or cock is fitted in the vessel A, near the bottom, to turn off the liquid when required. If necessary, a furnace J, to keep the water heated, is applied, and in that case a flue will be necessary, as shown at K, The vessel A, can be heated by gas, or by any other suitable apparatus.

The patentee claims, "the general improved construction and arrangement of the different parts of the washing machine, as described."

To WILLIAM EDWARD NEWTON, *of Chancery-lane, for improvements in printing machinery,—being a communication.*—[Dated 16th November, 1864.]

THIS invention relates to certain improved mechanical arrangements for delivering the printed sheets from the impression cylinders, and depositing them in piles on tables provided for the purpose. The invention is more particularly applicable to the fast printing machines, known as Hoe's rotary circular-bed printing machines; but it may

also be advantageously adapted to other printing machines, in which a large number of sheets are required to be delivered in rapid succession, with little or no space or interval between the end of one sheet and the commencement of the succeeding sheet.

In Plate XII., fig. 1 represents, in elevation, an arrangement, in which two sets of carrying tapes *a*, *a*, *a*, and rollers a^1, a^1, a^1, are to be placed one above the other, and as near together as possible, Both sets are mounted in a vibrating frame *b*, which moves on a centre pin b^1, fixed in the stationary framing. By this arrangement, the carrying tapes *a*, and rollers a^1, may be moved up or down in a vertical direction, as indicated by dotted lines, in order to bring the nip of first one set of tapes and then of the other opposite to the bite of the delivery rollers *c*, *c*. A guide bar *d*, placed between the delivery rollers and the carrying tapes, directs the issuing edge of the printed sheets first to one set of tapes and then to the other. In this way, each set of carrying tapes will only have one-half of the printed sheets to dispose of, and will, consequently, have ample time to deposit them on the table by means of the fly frames *e*, *e*, as is well known.

An obvious modification of this arrangement is to mount the rollers and pulleys a^1, of the carrying tapes *a*, in a stationary frame, and to move the delivery rollers *c*, *c*, up and down, so as to bring them alternately opposite to the grip of the sets of carrying tapes *a*, *a*; in order that the printed sheets, as they issue from between the delivery rollers *c*, may be delivered first to one set of tapes and then to the other, and conveyed by them to the fly frames *e*, *e*, whereby the printed sheets are deposited on the tables *f*, *f*.

Fig. 2 represents, in elevation, another arrangement, in which the forward edges of the printed sheets, as they issue from the delivery rollers *c*, *c*, are blown, by means of an intermittent blast from the air pipes *g*, g^1, into the grip of or against first one and then the other set of carrying tapes *a*, *a*. To this end there are two horizontal air pipes *g*, g^1, placed one above the other, below, near the grip of the delivery rollers *c*, *c*. These pipes communicate with two vertical air pipes g^2, g^2, which are connected with two pumps *n*, *n*, for the purpose of letting on the air to the pipes *g*, g^1, alternately. These pumps *n*, are operated at the proper moment by means of a pair of excentrics *o*, o^1, on the bevil wheel shaft *p*. The under one of these pipes g^1, is perforated with holes on the top side, and the other one *g*, on the bottom side; and, as the printed sheets pass between them, a blast of air is caused to issue from the holes in one or other of these pipes alternately, so that the sheets will be blown either up or down, and thereby directed into the grip of or against either the top or bottom set of carrying tapes *a*, *a*, as the case may be. The blast of air required for this arrangement may, if desired, be obtained from a reservoir of compressed air, conveniently placed for the purpose; or the cranks or excentrics *o*, o^1, on the shaft *p*, may be made to act on a bellows, or on the air pumps, as at *n*, and thus force and compress air into the pipes g^2, or into a compressed air reservoir, from whence it will pass through the pipes g^2, g^2, into the perforated pipes *g*, g^1.

Another mode of directing the printed sheets alternately to the upper and under set of carrying tapes, is shown at fig. 3, and consists in the employment of the vibrating or oscillating direction bar *h*, which

is placed opposite to the nip of the delivery rollers c, c, and, as it oscillates on its centre of motion, it will direct the sheets either to the right or to the left, as may be required. The oscillating directing bar h, is actuated by means of a rod i, connected to a weighted lever j, which is operated by a cam on the shaft k.

The fly frames e, which receive the printed sheets from the carrying tapes a, a, and deposit them on the tables, are of the kind usually employed in Hoe's circular-bed rotary printing machine, and, therefore, require no description, further than to say that they are actuated by the cams l, l^1, which are rotated by means of the bevil gear shown in the drawings, or by any other convenient mechanism connected with the working parts of the machine.

The patentee claims, "The adaptation to the delivery rollers of fast-printing machinery of two or more sets of conducting tapes and rollers, for the purpose of carrying away and conducting the printed sheets to separate fly frames and tables, as set forth."

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

April 11th, 1865.

CHARLES HUTTON GREGORY Esq., Vice-President, in the Chair.

The paper read was "*On the Festiniog railway for passengers—as a 2-feet gauge, with sharp curves, and worked by locomotive engines*," by Captain H. W. Tyler, R.E., Assoc. Inst. C.E.

This line was designed to facilitate communication between the principal slate and other quarries in the county of Merioneth and the shipping places, and for the conveyance of coals and other heavy articles to the quarries and mines. As in 1832, when the act for its construction was obtained, the population was very limited, the line was laid out in an economical manner, with a width between the rails of 2 feet only. It commenced at Portmadoc, and after passing along the Traeth Mawr embankment, it ascended to the mountain terminus at Dinas, the level of which was 700 feet above the station at Portmadoc, by an average gradient of 1 in 92, for 12¼ miles—the total length of the line being 13 miles. The steepest gradient on the portion now used for passengers was 1 in 79·82, and on that traversed by locomotive engines 1 in 60. Some of the curves had radii of 2, 3, and 4 chains. The maximum super-elevation of the outer rail on 2-chain curves was 2¼ inches for a speed of 8 miles an hour. The estimated cost of the line was £24,185, but the parliamentary capital was raised to £50,185.

The quarries being situated at different altitudes in the mountains, the slates were first brought down the quarry inclines to the railway, and the trucks were collected until fifty or sixty had accumulated to

form a train, which was then allowed to run down by gravity. Until the year 1863, the empty trucks, or those loaded with coals, goods, furniture, materials, machinery, and tools for the quarries and the neighbourhood, were drawn up by horses, which travelled down with the trains, as on mineral or colliery lines in the North of England. As the traffic increased, the line was gradually improved, by flattening the curves, by making better gradients, and by improvements in the permanent way, and as the trade still continued to progress, the practicability of employing locomotives was constantly discussed. The apparent difficulties caused the idea to be more than once abandoned; but ultimately, in June, 1863, two locomotive engines, designed by Mr. England, under the direction of Mr. C. E. Spooner, the engineer to the company, were placed upon the line, and, having been found to be successful, two others were subsequently supplied. These four engines had run 57,000 miles up to February, 1865, without leaving the rails. During the last autumn, the company carried passengers without taking fares, but at the commencement of the present year the line was regularly opened for passenger traffic. In ascending from Portmadoc, the passenger carriages were drawn by the engines with other vehicles, the passenger carriages being placed between the empty slate trucks, which were always last in the trains, and the goods waggons, which were next behind the tender. In descending, the loaded slate trucks, with empty goods trucks attached behind them, ran first in a train by themselves, the engine followed, tender first, and the passenger vehicles brought up the rear, with a break in front, but detached from the engine and tender, and at a little distance behind them. The speed was limited to about 6 miles an hour in passing round the sharpest curve, and to 10 miles an hour on other parts of the line.

The engines were somewhat similar to, though much smaller than, those which had been found so useful to contractors. There were two pairs of wheels, coupled together, and 5 feet apart from centre to centre, the wheels being each 2 feet in diameter. The cylinders, which were outside the framing, were 8 inches in diameter, with a length of stroke of 12 inches, and they were only 6 inches above the rails. The maximum working pressure of the steam was 200 lbs. to the square inch. Water was carried in tanks surrounding the boilers, and coal in small four-wheeled tenders. The heaviest of these engines weighed 7½ tons in working order, and they cost £900 each. They could take up, at 10 miles an hour, about 50 tons, including the weight of the carriages and trucks, but exclusive of that of the engine and tender. They actually conveyed daily, on the up journey, an average of 50 tons of goods and 100 passengers, besides parcels. Two hundred and sixty tons of slates were taken down to Portmadoc daily. The engines were well adapted for convenience in starting and in working at slow speeds; but their short wheel base, and the weight overhanging the trailing wheels, gave them more or less of a jumping motion when running. Safety guards, similar in form to snow ploughs, had been added in front of the engines, behind the tenders, and under the platforms of the break-vans. in consequence of their being so near to the rails.

The passenger carriages were 6 feet 6 inches high in the middle above the rails, 10 feet long, and 6 feet 3 inches wide. They were on

four wheels, 18 inches in diameter, and 4 feet apart from centre to centre of the axles. There was a longitudinal partition down the centre, and the passengers were seated back to back, so as to avoid overhanging weight outside the rails. The second and third, costing £100 each, did not differ from the first class carriages, which cost £120 each, except in their fittings. Each carriage would convey ten passengers. The floors of the carriages being only 9 inches above the rails, no platforms were required; and there being no break in the longitudinal partitions, the passengers got in and out through doors on both sides. There were also some open cars for summer use, without sides or roof, into which the passengers were strapped by means of longitudinal and cross straps. The couplings were central, 15 inches above the rails, and working upon volute springs. The buffers were also central, and were 4½ inches above the couplings.

The rails weighed 30 lbs. to the lineal yard, and were supported in cast-iron chairs, weighing 13 lbs. at the joints, and 10 lbs. each in the intermediate spaces, placed upon transverse sleepers of larch. In transforming this horse-tramway, thirty-three years old, into a passenger line worked by locomotives, the narrowness of the works, among other things, caused some difficulty. The author thought that, in all new lines, a minimum distance of 2 feet 6 inches should be preserved between the sides of the carriages and the works, and that where there were two lines of way, an intermediate space of 7 feet should be allowed, to admit of the doors of the carriages in one train swinging clear of those of another train.

The author conceived that the employment of locomotive engines on this little railway, and its opening for passenger traffic, were not only highly interesting experiments, but were likely to be followed by important results. Although there were still, doubtless, numerous districts where railways on a gauge of 4 feet 8½ inches might be profitably made, yet there were also many others in which lines of cheaper construction were required. With a narrower gauge, lighter rails and sleepers, less ballast, and cheaper works generally might be adopted; sharper curves might be laid down; very heavy gradients, particularly in mountainous regions, might be more cheaply avoided; and lighter engines, with lighter vehicles, might be made to do all the work, where high speed was not demanded, and where the traffic was not heavy.

The Norwegian government, as appeared from a report by Mr. C. D. Fox, had in operation two lines on a gauge of 3 feet 6 inches—one from Grundsett to Hamar, 24 miles long, the other from Trondlijen to Staren, 30 miles long. The former, with gradients of 1 in 70 and curves of 1000 feet radius, had cost, including rolling stock and stations, £3000 a mile. The latter, through a more difficult country, with gradients of 1 in 42, and curves of 700 feet to 1000 feet radius, had cost £6000 a mile. The engines weighed 14 tons in steam, and the speed was about 15 miles an hour, including stoppages. A further length of 56 miles was in course of construction, and no other gauge was contemplated for the traffic of that nation.

It was, however, illegal at present to construct any passenger lines in Great Britain on a narrower gauge than 4 feet 8½ inches, or, in Ireland, than 5 feet 3 inches. Consequently, it would appear to be desirable

to endeavour to obtain the repeal, or at least a modification of the provisions, of the Act 9 and 10 Vict., cap. 87, which regulated the width of the gauge of passenger lines, as there was now an increasing demand for railways of a minor class. Many coal and mineral lines on a less gauge than 4 feet 8½ inches were in use, and others were projected, with ultimate views of passenger traffic; and it would be advantageous if some narrower gauge were recognised. Whether the exact gauge should be 2 feet, 2 feet 6 inches, or 3 feet, or any other dimension, it was believed there could be no question that a system of branch lines, costing two-thirds of those now ordinarily constructed, and worked and maintained at three-fourths of the expense, would be of great benefit to Great Britain and Ireland, and would be most valuable in India and the Colonies—in fact, wherever there were people to travel, produce to be transported, resources to be developed—in cases in which it would not be commercially profitable to go to the expense, at the outset, of a first-class railway.

April 25th, 1865.

J. R. McCLEAN, Esq., President, in the Chair.

May 2nd, 1865.

JOHN FOWLER, Esq., Vice-President, in the Chair.

The paper read was, "*On uniform stress in girder work; illustrated by reference to two bridges recently built,*" by Mr. Callcott Reilly, Assoc. Inst. C.E.

This communication was suggested by a previous discussion at the Institution, when Mr. Phipps (M. Inst. C.E.) condemned the trough-shaped section, commonly adopted for the top and bottom members of truss girders, because the intensity, per square unit, of the stress upon any vertical cross section, was necessarily variable, when the connection of the vertical web with the trough was made in the usual manner. In the construction of the iron work of the two bridges under consideration, attention was invited chiefly to those details which were designed with the object of carrying out, as nearly as possible, in every part of the girders, the condition of uniform stress.

After alluding to the distinction drawn, by Professor Rankine, between the words "strain" and "stress," and to his definition of "uniform stress," in which the "centre of stress" or "centre of pressure" must be coincident with the centre of gravity of the surface of action, and of "uniformly varying stress," when the centre of gravity deviated from the "centre of stress" in a certain known direction, it was remarked, that the failure of any member of a girder would begin, where the resistance to strain was really least, that was where the intensity of the stress was greatest; from which it followed, that the opinion which upheld as right in principle the trough-shaped section,

as applied in the usual manner, must be a mistake And, moreover, every form of section, of any member of a girder, or other framework, which did not admit of the approximate coincidence of the centre of stress with its centre of gravity, was liable in degree to the same objection.

The two bridges illustrated different conditions of loading,—one carrying the platform on the top, the other having the platform between the main girders near the bottom. Both were of wrought iron, and both exhibited an economy of material in the main girders, that, so far as the author was aware, was not common, at least in this country. In order to determine the causes of this economy, a comparison was made with two other forms of truss more generally adopted. In one bridge, over the River Desmochado, on the line of the Central Argentine Railway, the pair of trusses, 93 feet 4 inches span between the centres of bearings, was designed to carry, in addition to the fixed load, a moving railway load of 1 ton per foot of span for a single line of way, with a maximum intensity of stress of 5 tons per square inch of tension, and of 3½ tons per square inch of compression; and the total weight of wrought iron in the framework of the pair of trusses was 18 tons. The cast iron saddles, rivetted on at the ends, weighed 9 cwt.; if these were included, the weight of iron, both wrought and cast, in the pair of trusses, was under 4 cwt. per lineal foot of span.

The other bridge, over the Wey and Arun Canal, on the Horsham and Guildford Railway, was 80 feet span between the centres of bearings; it was designed to carry, in addition to the fixed load, a moving load of 1·875 ton per foot of single line of way, at the same maximum intensity of stress as in the other case; and the total weight of wrought iron in the pair of trusses was 20 tons 18 cwt. The cast iron saddles weighed 5¼ cwt. each; bringing up the weight of both wrought and cast iron in the pair of trusses to 5½ cwt. per lineal foot of span. This weight was greater than in the first bridge, although the span was less; but the intensity of the moving load was 87½ per cent. greater, and the roadway lying between the trusses instead of on the top, its weight was necessarily much greater. The cross girders were also heavier, each being adapted to support, separately, the heaviest load that could be brought on by a driving axle weighted with 16 tons: the moving load thus brought upon each cross girder, and to which its strength was proportioned, was 18 tons, equal to 2¼ tons per foot of span of bridge.

The particular form of truss chosen for these two bridges was that extensively known in the United States as the Murphy-Whipple Truss. Each of these trusses was minutely compared, according to the plan adopted on a previous occasion by Mr. Bramwell (M. Inst. C.E.), with two equivalent trusses of the types generally used in this country—viz., the Warren truss, with bars making an angle of 63° 26′ with the horizon, and the simple diagonal truss with two sets of triangles, the bars crossing each other at the angle of 45°;—the various circumstances of ratio of depth to span, which was as 1 to 10, and of application and distribution of load, and consequently the number and position of the loaded joints, being common to the three trusses.

The details of the comparison were fully given in the paper, and the proportionate results arrived at in the two cases were exhibited in the

following tables, relating to the trusses of the two bridges, contrasted respectively with the other equivalent trusses:—

BRIDGE No. I., WITH LOAD ON THE TOP.

	No. 1. Murphy-Whipple Truss.	No 1A. Warren Truss.	No. 1B. Diagonal Truss.
	Units.	Units.	Units.
Theoretical weight...	250	237·5	227
Weight of transverse stiffening to struts	17·4	29·2	42·2
Excess of practicable minimum over theoretical minimum	6·18	11·5	31·6
Total weight, exclusive of joints and packings... ...	273·58	278·2	300·8

From this it appeared that the least practicable weight of No. 1 truss was less than that of No. 1A by only 1·7 per cent. It might, therefore, be said that, practically, the two trusses were equal in point of economy; and that there could be no motive for preferring one to the other, except such as might arise from considerations of workshop convenience and facility of construction. The advantage, in point of economy of weight, of No. 1 over No. 1B, was more decided, being 10 per cent.,—sufficient, it was submitted, speaking generally, and without denying that special circumstances might, in particular cases, justify a choice of the heavier truss, to entitle No. 1 to a preference over No. 1B.

BRIDGE No. II., WITH LOAD ON THE BOTTOM.

	No. 2. Murphy-Whipple Truss.	No. 2A. Warren Truss.	No. 2B. Diagonal Truss.
	Units.	Units.	Units.
Theoretical weight...	237·8	237·5	228
Weight of transverse stiffening to struts	6·6	16·1	26
Excess of practicable minimum over theoretical minimum	11·98	13·42	32·82
Total weight, exclusive of joints and packings... ...	256·38	267·02	286·82

It thus appeared that No. 2 Truss was lighter than either of the others by 4·15 and 11·87 per cent. respectively.

With regard to the peculiarities of detail of the two bridges, it was remarked that, in order that the stress might be uniformly distributed over the surface of any cross section of either "boom," it was necessary that the two halves of the double web of each truss should each support exactly one half the load upon that truss. This, it was urged, could not be realised by the ordinary modes of fixing the cross girders;

but, in the cases under consideration, it was arrived at, by supporting the cross girders in the middle of the width of the truss. Thus, in Bridge No. I., each cross girder rested upon a light cast-iron saddle, or bridge, which spanned the width of the top boom, and had its bearing partly upon the top edges of the vertical struts, and partly upon rivets passing through it, the struts, and the vertical side-plates of the top boom, in such a way that the line of action of the vertical force, transmitted from the cross girder to the truss, coincided exactly with the vertical centre line of its width. In Bridge No. II. a different arrangement was necessary. In that case each vertical strut consisted of two pairs of angle irons, separated, in the plane of the truss, by a space just wide enough to permit the end of the cross girder to pass in between the pairs. At the same level as the cross girder a plate was rivetted to each pair of angle irons; and to the centres of these plates the cross girder was also rivetted, so that the weight was equally divided between the four vertical angle irons, and the resulting stress was equally distributed between the two halves of each boom. In both bridges, the centre lines of the vertical struts, the diagonal ties, and the top and bottom booms, intersected each other at the centre of gravity of the group of rivets, which attached each strut and tie to the boom, and, in order to satisfy the condition of uniform stress, all the centre lines were axes of symmetry. In the top booms of both bridges a section had been adopted which was believed to be new. It was somewhat like an elongated capital letter H, or like a common plate girder placed upon its side; the horizontal web, or diaphragm, being only sufficiently thick to ensure lateral stiffness. In this section, all the centre lines were axes of symmetry, and consequently intersected each other in its centre of gravity; and the horizontal axes were easily made to intersect the centres of gravity of the web joints. The chief mass of metal was also placed immediately contiguous to the bars of the web, which transferred the stress to the boom,—instead of being at some distance from them, as in the trough-shaped and T-shaped form of boom. The material was likewise disposed in the best possible manner for resisting vibration; while this section gave complete facilities for examination and painting. The ends of each truss rested upon hinged bearings, by means of cast-iron saddles rivetted to the junction of the endmost bars of the truss, rollers being provided at one end.

The means adopted, in the design of these girders, to obtain the utmost economy of weight, consistent with moderate economy of workmanship, were:—The closest practicable approximation of the average strength to the minimum strength; the observance throughout of the condition of uniform stress, in order that all the compressed members might be trusted with the least possible weight of stiffening; the preference of rivetted web joints to those formed by single pins; and such an arrangement of the rivetting, that every bar or plate subject to tension, should have its whole width, less the diameter of only one rivet-hole, available to resist the tensile force applied to it.

Lastly, the author demonstrated the true value of the condition of uniform stress, by an exact comparison of the state of a bar of the top boom of the truss of Bridge No. II., when under uniform stress, with that condition of unequally distributed stress that would occur if the

boom had a suitable trough-shaped section of equal area, breadth, and depth, and therefore of equal nominal value; the elasticity of the material being assumed as perfect. The first case considered was where the stress was uniform in intensity, and the second in which the stress was unequally distributed. The final result was denoted by the equation $p = p_0 \pm \frac{x \, L \, P}{I}$; and applying this formula* to the case of the trough-shaped section of boom, supposed to be equivalent to the H-shaped section actually used, the following was obtained:—The area of section was exactly the same, being 36·17 square inches. The inside depth of the trough, 10 inches, would permit precisely the same disposition of the rivets in the web-joint, so that the centre of pressure was situated at the same perpendicular distance, 5 inches from the lower edges of the trough, as from the edge of the H-shaped section actually used. The centre of gravity was found to be situated at 8·088 inches perpendicular distance from the lower edge of the trough, and 2·537 inches from the top edge. The magnitude of the total stress upon the section was 125 tons. The uniform intensity of the stress was 3·45 tons per square inch; and the moment of inertia, with respect to the axis, was 336·892. From these data the greatest stress was found to be 12·717 tons per square inch at the extreme edges or corners of the sides, and the least intensity 0·544 ton per square inch along the extreme bottom of the trough. In this result the effect of flexure was purposely omitted.

In summing up the conclusions sought to be established, it was submitted that:—

First, a comparatively small deviation of the centre of the stress, upon the cross section of any bar, of any piece of framework, from the centre of gravity of that section, produced, within the limits of elasticity, a very great inequality in the distribution of the stress upon that section.

Secondly, if it were conceded that the real strength of every structure was inversely proportional to the greatest strain suffered by its weakest member, then the existence of this unequal distribution of the stress must be detrimental to the strength of any structure in which it existed, and which had been designed on the supposition that the mean intensity of the stress upon any bar was necessarily a correct measure of its strength.

Thirdly, there was no practical or theoretical difficulty in designing a truss or girder, in which the stress upon every cross section, of all the important members at all events, should be absolutely uniform.

Fourthly, the condition of uniform stress was perfectly consistent with the utmost economy of material in the structure to which it was applied.

* In this formula, p is the intensity of the stress per unit of area at the distance x from the neutral axis of the stress, which intersects the centre of gravity of the section. p_0 is the intensity of the stress considered as uniformly distributed over the surface of section,—that is, the total stress P upon the entire surface of section divided by the area of that surface. L is the perpendicular distance of the centre of pressure from the neutral axis, and I is the moment of inertia of the surface with respect to that axis. x is $+$ or $-$, according as it is measured on one side or the other of the neutral axis.—C. R.

MECHANICAL ENGINEERS' SOCIETY.

ROBERT NAPIER, Esq., President, in the Chair.

At the Annual Provincial Meeting of the Members, held in the Institution Rooms, St. George's-place, Glasgow, commencing 2nd August, 1864, the following paper, "*On the mechanical appliances of the Loch Katrine Water Works for the supply of Glasgow*," by Mr. James M. Gale, of Glasgow, was read:—

Previous to 1860, that part of Glasgow lying on the north bank of the river Clyde, or about three-fourths of the whole city, was supplied with water drawn from the river at two pumping stations $2\frac{1}{2}$ and $3\frac{1}{2}$ miles above Glasgow Bridge respectively. The remaining part of the city, that on the south side of the river, was supplied, and in greater part is still supplied, by the Gorbals gravitation works, established in 1847 on a small stream about 7 miles south of the city. The impure quality of the water drawn from the river had induced the corporation of Glasgow to purchase the whole of the works from the two existing water companies, and to promote a scheme for supplying the city from Loch Katrine, the well-known Loch in the Perthshire Highlands. The works were commenced in 1856, were opened by her Majesty on the 14th October, 1859, and were completed, and the water introduced to the greater part of Glasgow, early in 1860. The whole works were executed from the designs and under the superintendence of Mr. J. F. Bateman.

The drainage area to the Loch Katrine Water Works amounts to 45,800 acres, or about 72 square miles, and includes Loch Katrine, Loch Achray, Loch Vennachar, and Loch Drunkie. Loch Achray has not been appropriated for the use of the water works, but works have been constructed at the outlets of the three other lochs, whereby a large amount of storage has been obtained at comparatively little cost. A masonry dam, with four sluices and a waste weir 100 feet long, have been erected at the outlet of Loch Katrine. The level of the water is thus raised 4 feet above its former summer level, and the sluices also admit of the water being drawn down 3 feet below the former summer level; thus giving a control over the contents of the loch to the extent of 7 feet in depth, and a storage capacity amounting to 910 million cubic feet. Around the margin of the loch an additional area of water is obtained, by the raising of the loch, as also in the case of Loch Vennachar and Loch Drunkie. The drainage area to Loch Katrine alone is 22,800 acres, and the area of the loch itself at its summer level 3000 acres, or about one-seventh of the whole drainage area. The district is very rugged and mountainous, and in some places, especially near the pass of the Trosachs, very picturesque. The level of the water in Loch Katrine is 362 feet above the level of the sea; and the lip of the basin which surrounds it, except near the point where the water is drawn off into the aqueduct, has a minimum elevation of 1000 feet above the sea, and at one place, Ben Venue, rises to 2388 feet. The rocks of the district are micha schist, one of the primary deposits, and

are precipitous, very hard, nearly insoluble, and yielding water of great purity. The water drawn from the loch contains only about 2¼ grains of soluble matter per gallon, and has a hardness of 0·8° on Dr. Clark's scale, in which a hardness of 1° is that due to one grain of chalk dissolved in one gallon of distilled water, the hardness being the property of destroying soap. The district contains very little land that can be cultivated, and the covering of soil or peat on the top of the rock is not deep enough to affect the colour of the water in the loch, even during high floods. Also, there need be no apprehension of the quality of the water ever becoming injured by agricultural operations, or by drainage from populous districts: at present, there are only ten houses on the 36 square miles of country which drains into the loch. The fall of rain in the district is very great; in the valley of the Duchray, on the eastern side of Ben Lomond, and in Glen Gyle, at the head of Loch Katrine, there is in some years a fall of 100 inches; while in the more open country lower down the valley, the fall is about six-tenths of that higher up.

The works at the lochs have been arranged on a scale sufficient to ensure a supply to Glasgow, during the driest season, of 50 million gallons a day, and to provide compensation water to the river Teith in addition. The supply for the city is drawn exclusively from Loch Katrine, and the compensation water principally from Loch Vennachar and Loch Drunkie. The compensation water was fixed by agreement with the proprietors, and others having an interest in the rivers Teith and Forth, at 40,500,000 gallons per day, or an average of 4500 cubic feet per minute, to be given out from Loch Vennachar at the rate of 6000 cubic feet per minute, from 1 o'clock a.m. to 1 o'clock p.m., and 3000 cubic feet per minute from 1 p.m. to 1 a m. of each day in the year.

This additional quantity of water has been obtained by constructing a masonry dam at the outlet of Loch Vennachar, with a waste weir 150 feet long. The dam is 110 feet long, and is furnished with eleven cast-iron sluices to regulate the flow of the water, the top of the dam being carried up and roofed in to form a protection for the working gearing of the sluices. The loch has been raised by the dam 5 feet 9 inches above its former summer level, and it can be drawn down by the sluices 6 feet below the summer level. A new channel was cut for the river, 700 yards long and 50 feet wide, in order to allow of the water in the loch being drawn down to this further depth. The compensation gauge weir, placed at the lower end of the new river channel, consists of a continuous cast-iron plate, 100 feet long, brought to a thin edge at top, over which the water flows with a depth of 3¼ to 5¼ inches, when the statutory quantity only is being discharged. The area of Loch Vennachar, at its former summer level, was 865 acres, and at the level to which it has been raised it is about 1000 acres. The storage capacity included in the range of level of 11 feet 9 inches depth, afforded by the works, is 425 million cubic feet.

The works at Loch Drunkie consist of two earthen embankments, with puddle in the centre of each, protected by stone facing on the inner slopes in the usual manner. The northern embankment is 150 yards long, and the other, which is at the original outlet of the loch, is 40 yards long. The level of the loch has been raised 25 feet, and the

area increased from 78 to 137 acres, thus affording storage to the extent of 120 million cubic feet. The water is discharged from the loch by a cast-iron pipe, 24 inches diameter, laid through the deepest embankment.

The total amount of storage provided by the works at the three lochs is, therefore, 1455 million cubic feet, equal to a supply for 100 days of 50 million gallons per day for the city, and 40⅓ million gallons per day for compensation water to the river Teith, without taking into account the natural flow of the streams running into the lochs. At the present rate of consumption of water in the city, this storage is equal to 152 days' supply, including the compensation water.

As the Teith is a good salmon river, it was necessary to provide for the passage of the fish at the masonry dams at the outlets of Loch Vennachar and Loch Katrine. This has been done at Loch Vennachar by forming four salmon stairs, at different levels, to suit the varying level of the loch, of a width of 6 feet between the side walls. The stairs have a general inclination of 1 in 12, and terminate at the upper end next the loch with cast-iron sluices, which open by being moved downwards, thus allowing the water to fall over as over a weir. The sloping channels are formed into a succession of deep pools, by planks upon edge placed across the channel, over which the water falls a depth of from 15 to 20 inches to the lower level. At Loch Katrine there are only two of these salmon stairs, but otherwise the arrangements are similar.

The point of inlet, where the water is drawn from Loch Katrine into the aqueduct for the supply of the city, is about 5 miles from the bottom of the loch and 2½ miles from the top. The water is first admitted from the loch into a basin 55 feet long by 40 feet wide inside, through three cast-iron sluices, each 4 feet square. Across the middle of the basin is fixed a line of strainers, to keep fish, &c., from passing from the loch into the aqueduct. The outlet sluices, for discharging the water from the outlets of Loch Katrine and Loch Vennachar, as well as the inlet sluices from Loch Katrine to the aqueduct, are of similar construction. The sluice plates are of cast iron, faced with brass, and working against brass faces on a cast-iron frame, which is securely let into the masonry, and is furnished with guides to keep the sluice-plate in its place. The sluice is raised and lowered by means of an iron screw working in a brass nut, the screw being turned by a crank and bevil wheels at top.

The length of the aqueduct, from Loch Katrine to the service reservoir at Mugdock, near Milngavie, is 25¾ miles, and from this reservoir to Glasgow is about 8 miles more; making a total length from Loch Katrine to Glasgow of about 34 miles. The built and tunnelled part of the aqueduct is 22 miles long; it is 8 feet high by 8 feet broad, and has a uniform inclination towards Glasgow of 10 inches per mile, or 1 in 6336, and it is all capable of passing 50 million gallons per day. The valleys of the Duchray, the Endrick, and the Blane, which are crossed by the line of aqueduct, and prevent a uniform inclination being obtained throughout, make up an aggregate length of 3¾ miles, and are passed by cast-iron syphon pipes 48 inches diameter, with a mean fall of 1 in 1000 between their extremities. These pipes deliver a little over 20 million gallons per day; and at all the bridges and other places

where masonry was required, provision has been made for laying two additional lines of pipes when the increased consumption of water in the city may require this to be done.

The first work on the line of aqueduct upon leaving Loch Katrine is a tunnel through the ridge which separates the valley of Loch Katrine from that of Loch Ard. The point where the valleys approach nearest to each other was chosen, but, even there, the length of tunnel required is upwards of 1¼ mile, and it is at a depth of more than 500 feet below the top of the hill. Twelve shafts were sunk on the line of tunnel to facilitate the work, five of them being about 450 feet deep. The rock passed through in this tunnel, and in the greater part of the first 10 miles of the aqueduct, which is principally a series of tunnels, is mica slate of the hardest description. Along the margin of Loch Chon, the work at some of the faces did not progress at a greater rate than 3 lineal yards in a month, although it was carried on night and day. The cost of the gunpowder alone used in the contract, which extended 7½ miles from the loch, was £10,540; and the average cost of the aqueduct for the same length was more than £13 per yard, or £23,000 per mile.

The three main valleys on the line of aqueduct are passed by cast-iron syphon pipes, as already mentioned; but the minor ravines in the first 10 miles of the aqueduct are crossed by aqueduct bridges of iron. Besides a number of smaller ones, there are five extensive aqueduct bridges of this kind. One of these consists of a wrought-iron tube, 8 feet broad and 6½ feet high inside, extending over the deeper part of the ravines, supported at intervals of 50 feet by stone piers; and a cast-iron trough, also 8 feet broad and 6½ feet high, supported on a dry stone rubble embankment at either end of the wrought-iron tube, extending over the remaining part of the valleys where the ground is not so much depressed. The bottom and sides of the tube are 3-8ths inch thick, and the top 7-16ths inch thick, the whole being strengthened by angle and T iron. The plates of the cast-iron trough are 5-8ths inch thick, the dimensions of the largest being 4½ feet by 4 feet, and they are connected and strengthened by flanges with rust joints. The level of the tube is about 3 feet lower than that of the troughs at each end, so as to ensure the tube being always completely filled with water up to the top, in order that the top of the tube may be kept always at the same temperature as the sides, and the tube may not be racked by the strain that would arise from the top plates becoming heated by the sun if the water were not in contact with them. In order to allow of emptying the tube at any time, for painting or other purposes, a discharge valve is provided at one end of the tube, by which the water can be run off into the valley beneath.

The junction between the wrought-iron tube and the cast-iron trough is made by bolting the trough to a cast-iron bed-plate, and to upright cast-iron standards at each side. The tube rests upon a bolster of vulcanized india-rubber, placed in a groove in the bed-plate, and projecting sufficiently above the surface of the plate to allow for the requisite compression on the india-rubber for making a water-tight joint by the weight of the tube bearing on it, without allowing the tube to come down to a bearing upon the bed-plate itself. A similar india-rubber bolster is carried up each side of the tube, and compressed against it by

oak wedges, the bolster and wedges being contained in a recess in the upright standards. This arrangement leaves the wrought-iron tube free to contract and expand longitudinally under change of temperature, without risk of leakage. The heads of all the rivets are countersunk for a short distance on each side of the bearing parts of the tube. The india-rubber bolsters are 2 inches diameter both at the bottom and sides of the tube. They are in separate pieces, the bolster under the bottom extending from the back of the wedge box on one side, to the back of the wedge box on the opposite side. The joints of the bolsters at the bottom corners are made by butting the bottom ends of the vertical bolsters upon the top of the transverse bottom bolster, the bottom ends of the vertical bolsters being slightly rounded out, to fit the curvature of the bottom bolster. The side wedges are driven down tight on the ends of the bottom bolster. There are three oak wedges in each wedge box, with an oak feather, or tongue, let in to break the joints between the wedges, and to guide the centre wedge while being driven down. A flat strip of india-rubber is placed between the back of the wedge box and the outermost wedge. The wedges were carefully fitted before the feather grooves were made, and were put in with thick wet paint in the joints; the centre wedge was then driven down to tighten up the india-rubber bolster against the side of the tube.

The above construction of the iron aqueduct bridges was considered the most applicable in the first portion of the aqueduct, as no good building stone was to be obtained within any reasonable distance, and the roads were very badly suited for the carriage of materials. From the eleventh mile to the reservoir at Mugdock, however, good building stone was abundant; and all the aqueduct bridges in that district are therefore of stone. There are in all 25 important iron and stone bridges, some of them of considerable magnitude; and about 80 distinct tunnels, varying in length from 1½ mile downwards, and forming a total length of 13 miles. Where the aqueduct was formed in open cutting, the ground was filled in and the surface restored after the aqueduct was built. At the cast-iron troughs of the iron aqueduct bridges, and at the other bridges, the water way is covered with planking, to prevent snow from choking the aqueduct. Grooves to receive stop planks are cut in the masonry of the aqueduct at intervals, and most of the bridges are provided with overflows and discharge sluices. The latter are similar in construction to the outlet sluices at the lochs, but of smaller dimensions.

The three valleys of the Duchray, the Endrick, and the Blane, which are of great width and depth, the second being more than 2 miles wide, are passed by means of the 48-inch cast-iron syphon pipes, carried down one side of the valley to the bottom, and up the opposite side. These pipes have the ordinary spigot and socket joints, the joint being made with lead and yarn. Some depressions on the line of these syphon pipes are crossed by flanged pipes, supported upon stone piers 18 feet apart, the joint being made by a ring of vulcanized india-rubber. In the Endrick valley, two public roads, and the Forth and Clyde Railway, are crossed by these flanged pipes; and, to support the pipes over these greater spans, cast-iron brackets are put in, abutting on the stone piers, which are thickened to receive them. The pipes are further strengthened at these places by projecting webs cast on them. It

was found that the contraction and expansion of these long lengths of flange-jointed pipes under changes of temperature injuriously affected the spigot and socket lead joints at each end; and, to obviate this, a felt covering, about ¾-inch thick, has been laid on all round the pipes, and protected from the weather by a tarpaulin cover laced tightly over the whole. This has had the effect of almost entirely obviating the inconvenience that arose from contraction and expansion.

The service reservoir at Mugdock has a water surface of 60 acres, and is 50 feet deep, the top water level being 312 feet above the level of the sea. It contains 548,000,000 gallons when full, equal to a supply for 29 days at the present rate of consumption; and thus admits of repairs being made upon the line of aqueduct without interrupting the supply to the city. The reservoir is entirely artificial, being formed by two earthen embankments, 400 yards and 240 yards long respectively. The water is first received from the aqueduct into a basin at the upper end of the reservoir, from which it flows over four cast-iron gauge plates, 10 feet long each, brought to a thin edge, into an upper pool or compartment of the reservoir, having an area of about 2 acres. The depth of water passing over the gauge plates is regularly gauged, the delivery from the aqueduct thereby computed, and the quantity of water passing every day into Glasgow is thus known. From the upper pool the water passes into the main reservoir over similar cast-iron gauge plates. The water is drawn from the reservoir by pipes laid in a tunnel cut through the rock in the solid, at the end of the main embankment, no pipes being laid through the embankments themselves. At the end of the tunnel next the reservoir there is a stand-pipe, with valves at different heights, which admit of water being drawn off at various levels. The water passes down the stand-pipe, and along a 48-inch pipe in the tunnel, for a distance of about 50 yards, to a circular straining well cut in the rock. Water can also be drawn direct from the aqueduct, or from the upper compartment of the reservoir, into the pipes leading to the city, without passing through the reservoir, by means of a line of 48-inch pipes laid through the bottom of the reservoir from the stand-pipe back to the upper end of the reservoir where the aqueduct enters.

The straining well is 40 feet diameter and 63 feet deep, cut out of the solid rock. Within it, and forming an inner chamber of octagonal shape, 25 feet diameter, a series of oak frames are placed, covered with copper wire cloth of 40 meshes to the inch. These are held in the eight cast-iron pillars, which have grooves cast in them to receive the frames. These wire cloth strainers occupy only the lower part of the well, the space above being filled in with wood planking up to the top water level of the reservoir. The water passes from the outside through the wire cloth strainers into the inner chamber, and is taken off thence to the city by two lines of cast-iron pipes 42 inches diameter. The water undergoes no filtration, but in passing through these copper wire strainers, any straws or other floating matters are separated from it. The pipes in the bottom of the straining well are provided with junctions and stop valves, so as to admit of the supply being drawn direct from the reservoir while the strainers are being cleaned; which is done by emptying the well, and throwing a jet of water upon the strainers from the inside outwards by

a leather hose with the head pressure of the reservoir, the foul water being carried off by a tunnel through the rock. The frames carrying the strainers can also be raised to the top of the well and taken out for repairs, by being drawn up through the grooves in the cast-iron pillars in which they are fitted. The top of the straining well is roofed in and partly covered with glass, as a protection to the working gearing of the stop valves. These valves are each divided into two halves, affording together a water way of the full diameter of the 42-inch pipes. Each half of the valve is opened and shut by an iron rod passing up through a cast-iron pipe, and terminating at a convenient height above the water level in a long brass nut, into which works a stationary iron screw, turned by a crank and bevil wheels.

The two lines of 42-inch pipes laid in the tunnel leading off from the straining well will deliver the whole 50 million gallons per day that the aqueduct is constructed to convey; but, on emerging from the tunnel, which is 440 yards long, they are diminished to 36 inches diameter; and provision is made for additional pipes being laid when they may be required. At the point where the pipes are reduced to 36 inches diameter, a self-acting throttle valve is fixed on each line of pipes, the object of which is to shut off the water coming from the reservoir in the event of one of the pipes bursting, or any other accident occurring, whereby the velocity of the water in the pipe is increased beyond that to which the valves are adjusted. These self-acting throttle valves were suggested by Sir William G. Armstrong, and first used in the Manchester Water Works; and have been subsequently introduced in the Liverpool Water Works.

At intervals along the line of the mains to Glasgow, and at several points in the city, stop valves are fixed in the large pipes. To admit of these valves being easily closed or opened, the slide is divided into two compartments, one being considerably smaller than the other. The smaller slide is the first opened, and the passage of the water through this opening so much reduces the pressure upon the larger slide, that it can also be opened with ease; the valve is thus easily worked by one man. To economize space, which is an object where large valves have to be placed in public streets, the total effective area of the valve has been reduced, in the case of these 36-inch valves, from 7 square feet, the area of the pipe, to 4½ square feet; the smaller slide having an area of 1 square foot, and the larger an area of 3½ square feet. To pass this contraction with the velocity that the water in the pipes will have when the discharge is greatest, the loss of head will be from 4 to 6 inches; but this loss is more than compensated for by the economy of the valve and the reduction in the dimensions of all the parts. The design of these valves is also due to Sir William G. Armstrong, and for large valves that have to be worked under great pressure, they leave nothing further to be desired.

The concussion caused in large pipes by suddenly closing the stop valves, requires to be guarded against; and this is done, to a considerable extent, by the construction of the stop valves themselves; but in order to reduce still further the risk from this cause, momentum valves are fixed on the pipes close to all the large stop valves, and behind the self-acting throttle valves. They are simply safety valves, constructed on the principle of the equilibrium, or double-beat Cornish valve, and

have been used both in the Manchester and Liverpool Water Works. Air valves are placed upon all the summits, and scouring cocks in the bottom of all the hollows on the mains. The scouring valves, as well as all the stop valves used in the city under 17 inches diameter, are the ordinary slide valves with double brass facings. The fire cocks used in Glasgow are of brass, upon the principle of the common ground cock, with the water admitted to the inside of the plug, which is hollow: the pressure of the water tends to force the plug into its seat, and thus to keep the cock tight. There are 2700 of these fire cocks in the city, placed at intervals varying from 40 to 60 yards; and also about 1200 fire cocks applied as cleansing cocks. The water meters used in Glasgow are those by Kennedy, of Kilmarnock, of which there are upwards of 500 in use, producing a revenue of £15,000 a year.

For the distribution of the water supply, the north part of the city is divided into a high and a low district. The high district is supplied by the 36-inch main from the Mugdock reservoir, which is brought in by Maryhill; and the low district by a main brought in by the Great Western Road. These mains, as well as the subsidiary mains in the city, are connected at intervals, so that an accident occurring to any one section of the mains, does not, to any serious extent, affect the general supply to the city. The large pipes only are connected; and each distributing pipe is furnished with a stop valve where it leaves the main, and a cleansing cock at the further end.

The quantity of water sent into the city from Loch Katrine during the first six months of the present year, averaged 19,100,000 gallons per day; and 3,400,000 gallons per day, in addition, were sent in from the Gorbals Water Works, on the south side of the river. Altogether, therefore, the total supply to Glasgow is 22,500,000 gallons a day, and this is distributed to a population of about 485,000 persons, being upwards of 45 gallons per head per day. Of this quantity, about 3½ gallons per head per day is sold by meter.

The cost of the Loch Katrine Water Works has been as follows:—

Construction of Works	£761,000	
Land, parliamentary expenses, engineering, and sundries	157,000	
		918,000
Add sums annually payable to proprietors in the two previous water companies, capitalised at 4 per cent		674,000
Total cost of the whole Water Works		£1,592,000

Provisional Protections Granted.

[*Cases in which a Full Specification has been deposited.*]

1865.

1040. Charles Boscham, Josef Bindtner, and William Caffou, of Vienna, impts. in lamps for burning petroleum, naphtha, or other mineral oils.—*April 12th.*

1067. Charles Robinson Fisher, of Chelsea, Massachusetts, U. S. A., impd. mode of connecting a gaff to the mast of a navigable vessel.—*April 15th.*

1128. John Emary, of Regent-street, impts. applicable to capes, paletots, over-coats, and other such like garments.—*April 22nd.*

1137. Henri Adrien Bonneville, of Paris, impts. in dissected maps and charts,—a communication.—*April 24th.*

1202. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in apparatus for spinning silk and other fibrous substances,—a communication.—*April 29th.*

1210. Charles Edward Herpst, of Paris, impts. in pumps,—a communication.—*May 1st.*

1233. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in machines for drying and stretching woollen and other textile fabrics,—a communication.—*May 3rd.*

1245. William Ford Stanley, of Great Turnstile, Holborn, impts. in straight line dividing engines and tools for regulating distances.—*May 4th.*

1256. Edward Richardson, of Ravensthorpe, Yorkshire, impts. in means and apparatus for producing or effecting fog signals.—*May 5th.*

1271. William Clark, of Chancery-lane, impts. in machinery for setting and distributing printing types,—a communication.—*May 8th.*

1348. Henri Adrien Bonneville, of Paris, impts. in flour mills,—a communication.—*May 15th.*

1864.

3140. William Allen Turner, of Clarges-street, Piccadilly, and Thomas Townsend Coughin, of Crucifix-lane, Bermondsey, impts. in the means of, and apparatus for, obtaining motive power, and for the distribution and application thereof.—*December 17th.*

3190. William Edward Gedge, of Wellington-street, impd. means and apparatus by the use of which a stripe or border may be woven on napkins, table cloths, and other fabrics, by the power loom,—a communication.—*December 23rd.*

Cases in which a Provisional Specification has been deposited.

1865.

48. Charles de Bergue, of the Strand, impts. in locomotive engines,—a communication.—*January 6th.*

84. Auguste Frederic Lendy, of Sunbury, impd. topograph.—*January 11th.*

109. Frederick George Mulholland, of Swan-street, Dover-road, and Thomas Dugard, of North-grove, Mildmay-park, impts. in bearings for general mechanical purposes, and the application of fluid metallic in lieu of oleaginous or other lubricants to prevent friction.—*January 13th.*

143. John Robinson and John Smith, of Rochdale, impts. in machinery or apparatus for planing and moulding or otherwise shaping wood.—*January 17th.*

149. Edward Deane, of the City, impd. kind of bedstead, suitable for camp and domestic purposes.—*January 18th.*

240. Charles De Bergue, of the Strand, impts. in furnaces.—*January 27th.*

255. Edward Thomas Hughes, of Chancery-lane, impd. system of drying wool, cotton, and other fibrous materials; and in the machinery or apparatus connected therewith,—a communication.—*January 28th.*

267. Matthew Cartwright, of Tavistock-street, Covent-garden, impd. apparatus and means for giving alarm in case of fire; applicable in part as impts. in alarms or alarums generally.—*January 31st.*

321. Clements Robert Markham, of Eccleston-square, method for removing or destroying the momentum of heavy bodies by means of an elastic machine or machines, so as to prevent injury and damage from concussion; applicable to ship cables, ship and fort armour, railway trains, tenders to pier heads and floating piers, gangways, breakwaters, and other similar structures; also as a motive power,—a communication.—*February 6th.*

382. Henry Emanuel, of St. Paul's Churchyard, impts. in boxing, fencing, and cricket gloves, and in cricket pads or guards.—*February 10th.*

439. Alexander Clark, of Gate-street, Lincoln's-inn-fields, impts. in burglar-proof and fire-proof safes.—*February 15th.*

524. John Shortridge, of Sheffield, impts. in the manufacture of chain cables.—*February 24th.*

538. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in the treatment of madder and the products obtained therefrom,—a communication.—*February 25th.*

542. Charles Whiting, of Lewisham, impd. portable frames and joints for tables and other articles; applicable also for building purposes and the like.—*February 27th.*

558. George Lauder, of Glasgow, impts. in machinery for mining coal and other substances,—a communication.—*February 28th.*

585. Samuel Chatwood, of Bolton, impts. in the manufacture of safes, and in apparatus connected therewith.—*March 2nd.*

601. Henry Everard Clifton and Abraham Hoffnung, of Liverpool, impts. in binding attachments for sewing machines.

604. Henri Adrien Bonneville, of Paris, impts. in apparatus for rinsing and drying by centrifugal force,—a communication.

605. Henri Adrien Bonneville, of Paris, impts. in washing machines,—a communication.

The above bear date March 4th.

671. Edwin Addison Phillips, of Milwaukee, Wisconsin, U.S.A., impd. rotary spader or digging machine for tilling land,—a communication.

678. Harry Whiteside Cook, of Angel Court, London, impts. in electric telegraphs,—a communication.

The above bear date March 10th.

705. Francis Wise, of Chandos Chambers, Adelphi, impts. in preparing certain colouring matters for dyeing and printing,—a communication.—*March 13th.*

712. Richard Archibald Brooman, of Fleet-street, impd. process for the production of photographic images capable of being inked with fatty inks,—a communication.

718. Longin Gautert, of Baden, impts. in machinery or apparatus to be employed in the bleaching and dyeing of hanks or skeins of yarns and threads.

The above bear date March 14th.

742. James Marshall, of Gainsborough, impts. in combined apparatus for threshing, dressing, and grinding grain and other agricultural produce.—*March 16th.*

745. Henri Adrien Bonneville, of Paris, impts. in railway breaks,—a communication.—*March 17th.*

804. Alfred Paraf, of Glasgow, impts. in dyeing and printing cotton or linen fabrics or yarns.—*March 22nd.*

811. John Burley and Lawrence Glover, of Birmingham, impd. method in the manufacture of toast racks.

813. Thomas Harvey Saunders, of Little Suffolk-street, Southwark, impd. means of ventilation by the use of perforated tubular cornices and centre-pieces.

818. Anthony Bernhard Baron Von Rathen, of Fitzroy-square, elementary power engine, or a new or improved compressed air engine, for imparting power and motion to all kinds of machinery.

822. Joseph Tall, of Bedford, impts. in the construction of walls, houses, and other buildings.

823. Thomas Roberts and Louis Luc, of Liverpool, impd. system of continuous self-acting and self-registering machinery for weighing grain, flour, and other ponderable matters.

The above bear date March 23rd.

828. William Simons and Andrew

Brown, of Renfrew, N.B., impts. in dredgers.
830. Alfred Baillot, of Brussels, impts. in sewing machines.
831. Thomas Farmer and Frederick Lewis, of Bilston, impts. in ornamenting the surfaces of japanned goods and papier-maché goods and other varnished surfaces.
832. William Loeder, of New Broad-street, London, impts. in the manufacture or construction of rails for railways,—a communication.
833. Robert Lublinski, of the City-road, impts. in umbrella and parasol tip fasteners.
834. John Bailey Brown, of St. Petersburgh-place, Bayswater, impts. in casks or vessels for storing petroleum and hydrocarbons.
835. Joseph Green, of Leeds, impts. in machinery or apparatus for cutting or chasing the threads of screws or worms.
836. William Edward Newton, of Chancery-lane, impts. in the manufacture of ink,—a communication.
837. James Andrew Swanzy, of Plymouth, impd. machine for washing, wringing, and mangling.
838. Daniel Arnold, of Cork, impts. in gun locks.
839. John Charles Stovin, of Whitehead's-grove, Chelsea, impts. in the means of communicating signals from passengers in railway trains to the guards and engine drivers.
840. Valentine Baker, of Cahir, Tipperary, Ireland, impts. in obtaining motive power, parts of which impts. are applicable to the compressing of air and gases.
841. Giacomo Felice Marchisio, of Baker-street, Middlesex, impts. in apparatus for obtaining light.
842. John Henry Johnson, of Lincoln's-inn-fields, impts. in the treatment of rice,—a communication.

The above bear date March 24th.

843. Edwin Wolverson, of Birmingham, impts. in the manufacture of ornamental metallic chains.
844. Henry Columbus Hurry, of Hereford, impts. in railway points and switches.
845. James Milton, of Glasgow, impts. in looms for weaving.
846. William Miller, of Glasgow, impts. in presses for cotton and wool.
847. Alice Isabel Lucan Gordon, of Prince's-gate, Hyde-park, impd. means of communication between the passengers, guard, and engine-driver of a railway train; part of which said impts. is also applicable for the prevention or detection of burglary.
848. Earle Harry Smith, of Sherwood, New Jersey, U.S.A., impts. in sewing machines, which improvements also involve or comprise a new mode of manipulating the threads of the needle and shuttle in forming the "lock-stitch."
849. Richard William Barnes, of Manchester, impd. apparatus for ascertaining the state of sewers, tunnels, drifts, or other subterranean work, part of which apparatus is applicable to levelling purposes.
850. John Dodd, of Oldham, impts. in mules for spinning and doubling.
851. William Richardson, of Oldham, impts. in cotton gins.
852. John Henry Johnson, of Lincoln's-inn-fields, impts. in spittoons,—a communication.
853. William Betts, of Wharf-road, City-road, impts. in protective labels for bottles, jars, and other similar vessels.
854. David Estler Blacke, of Belfast, impts. in the means and apparatus for utilizing the heat of steam.
855. William Clark, of Chancery-lane, impts. in the manufacture or preparation of materials for, and in their application to, lighting and heating purposes; also in apparatus used for the same,—a communication.
856. John Todd, of Greenwich, impts. in machines for planing and shaping metals.

The above bear date March 25th.

857. Charles Burfitt, of Bernard-terrace, Holloway, impd. domestic implement for paring potatoes, apples, and other like vegetables and fruit.
858. Herbert John Walduck, of Manchester, an impd. mode of, and apparatus for, communicating or signalling between the guards, passengers, and drivers of railway trains.

859. James Buckinham, of Westmorland-house, Walworth-common, impts. in oil feeders or cans,—a communcation.
860. Joshua Rooke, of Pimlico, impts. in double cylinder steam engines.
861. Carl Johan Laurentz Leffler, of Broad-street-buildings, impts. in casting ingots of steel and malleable iron.
862. Charles Matthews and John Fereday, of Wolverhampton, impts. in the construction of furnaces for the consumption of smoke.
863. John Bruckshaw, of Oakley Mills, Stafford, and William Scott Underhill, of Newport, impts. in traction engines.
864. Ferdinand Le Roy, of Saint Saulve, France, impts. in the non-conducting composition for preventing the radiation or transmission of heat or cold.
865. George Bishop, of Soho-square, impts. in apparatus for stamping and marking,—a communication
866. John Calvin Thompson and John James Malbourne Green, of Greenwich, impts. in the construction of railway carriages to facilitate the passage of the guard, or other person, from end to end of the train whilst it is travelling.
867. William West, of St. Blazey, Cornwall, impts. in preparing lubricating compounds.

The above bear date March 27th.

868. Joseph Williams, of Birmingham, impts. in ornamenting articles made of glass.
869. John Norris, junior, of Winchester, impd. apparatus for grooming horses.
870. James Millar and John Laing, both of Glasgow, impts. relating to apparatus for printing ornamental fabrics.
871. John Cornelius Craigie Halkett, of Cramond House, Mid-Lothian, N.B., impts. in paints or compositions used for coating iron or wooden vessels and other structures exposed to the action of sea water.
872. William Walsh, of Warrington, impts. in apparatus employed in the concentration of all solutions where quick or speedy concentration or evaporation is required.
873. Terrot Glover, junr., of Newcastle-upon-Tyne, impts. in the construction of ships' yards and spars.
874. Alexandre Denis Gascon, of Paris, febrifuge and digestive elixir,—a communication.
875. Frederick Thomas, of Bishopsgate-street Within, impts. in the construction of kitchen ranges having their fire-places enclosed.
876. François Adolphe Mocquard, of Paris, impts. in gas burners.
877. Richard Young, of Dublin, and Charles Finlay Oliphant Glassford, of Galway, impts. in the preparation or treatment of sea-weed, and in obtaining products therefrom.
878. Francis William Webb, of Crewe, impts. in the manufacture of steel tires for railway wheels.
879. Henry Welchman King, of Torrington-square, impts. in ventilating blinds.
880. Elliott Savage, of West Meriden, Connecticut, impts. in hardening and tempering steel.
881. Isac Louis Pulvermacher, of Oxford-street, impts. in fastenings for pins, buttons, and other articles with metallic backs.
882. Joseph Wright, of Dudley, impts. in forging machines.

The above bear date March 28th.

883. William Newton Wilson, of High Holborn, impts. in sewing machines.
884. William Irlam, of Newton-heath, near Manchester, impts. in cranes.
885. William Brookes, of Chancery-lane, impts. in file-cutting machinery,—a communication.
886. Richard Cardwell Robinson, of Cannon-street, London, impts. in machinery for the cutting of nails, brads, or spikes, and in the conformation of some of such nails and spikes.
887. Evan Leigh and Frederick Allen Leigh, of Manchester, impts. in machinery or apparatus used in carding cotton or other fibrous substances.
888. Frederick Allen Leigh, of Manchester, impts. in the construction of bridges and arches.
889. Richard Holroyd and Joseph Holroyd Bolton, of Manchester, impts. in machinery or apparatus for drying "warps" of cotton and other fibrous substances.

890. Alexander Chaplin, of the Adelphi, impd. apparatus for the instantaneous lowering and detaching of ships' boats.

891. John Player, of Stockton-upon-Tees, impts. in furnaces or apparatus for heating the blast for furnaces used in smelting iron, and for other furnaces.

892. Samuel Childs, junior, of Malcolm Villa, Putney, impd. method of treating fatty matters.

893. William Moxon Fuller, of Wolverhampton, impd. process for reducing or preparing waste animal matters, for the purpose of employing the same in the preparation of manures or fertilizing compounds.

The above bear date March 29th.

894. Thorsten Wilhelm Nordenfelt, of Montague-street, Portman-square, portable covered hammock,—a communication.

895. George Greenish, of Harpurhey, Lancashire, impd. arrangement of mechanism for propelling waggons in connection with railway hoists.

896. Walter Montgomerie Neilson, of Glasgow, impts. in shaping machines.

897. Benjamin Baugh, of Birmingham, impts. in the manufacture of reflectors for lamps, and of surfaces for reflecting light generally.

898. William Savory, of Gloucester, impts. in the treatment of meal and the dressing of flour, and the machinery and apparatus employed therein.

The above bear date March 30th.

New Patents Sealed.

1864.

2584. George Hartley.
2593. John Shaw.
2602. George Davies.
2603. J. E. A. Gwynne.
2606. C. H. Gardner and C. English.
2607. Arthur Reynolds.
2617. Andrew Muir.
2619. W. O. Walbrook.
2626. E. E. Colley.
2630. John Smith.
2631. J. W. Scott.
2633. H. Bateman and E. G. Garrard.
2635. G. T. Bousfield.
2636. J. Heap and T. Jolley.
2637. H. E. Craven & T. Carrack.
2638. James Tate.
2645. James Dannatt.
2650. B. F. Brunel.
2651. Frederick Jenner.
2652. J. and R. Cunningham.
2655. P. A. Le Comte de Fontainemoreau.
2657. J. Walmsley and N. G. Pitman.
2658. Charles May.
2661. John Stobo and W. Pollock.
2663. William Congalton.
2666. D. Laidlaw and J. Robertson.
2668. J. Charlton, H. Charlton, and J. O. Christian.
2673. William Cormack.
2678. A. and W. Smith.
2687. J. H. Simpson.
2688. C. O. Crosby.
2694. Edmund Edwards.
2695. J. F. Brinjes.
2700. P. A. Roger.
2703. William Aston.
2704. William Smith.
2705. Robert Richardson.
2709. Edward Pilkington.
2711. John Drury.
2715. C. W. Wardle and R. McIntyre.
2716. W. Davies, G. Cate, and W. Cate.
2719. C. Garton and T. Hill.
2720. E. T. Hughes.
2722. E. G. Brewer.
2723. H. W. Spencer and J. E. Ball.
2726. William Bayliss.
2729. James Dodge.
2730. H. B. Harris and J. P. Thomson.
2731. F. S. Gilbert.
2732. F. L. Bauwens.
2733. Frederick Yates.
2734. Frederick Yates.
2735. H. A. Gwynne.
2737. R. K. Bowley and K. T. Bowley.
2739. T. N. Kirkham and H. Brook.
2740. John Sullivan.
2741. Jacob Snider.
2742. J. R. Crompton.
2743. D. Ellis and M. Hillas.
2744. M. J. Roberts.

2748. A. Estourneaux and L. Beauchamps.
2751. William Thrift.
2753. George Simpson.
2762. Arthur Field.
2764. W. B. Adams.
2766. Richard Rimmer.
2769. L. C. Meaulle.
2770. Charles Garton.
2771. W. K. Hall.
2772. A. Bechim and H. Wedekind.
2773. J. H. Johnson.
2777. Ivan Rydbeck.
2778. J. D. Welch and A. P. Welch.
2779. G. B. Galloway.
2780. Stephen Dixon.
2785. J. Dale, H. Carro, and A. Martius.
2788. J. A. Manning.
2789. J. Robinson and J. Gresham.
2790. R. B. Cooley.
2794. J. M'Call and B. G. Sloper.
2795. T. L. Boote and R. Boote.
2797. Henry Brocket.
2801. W. L. Lees.
2803. William Clark.
2806. George Smith.
2807. John Kinniburgh.
2811. W. C. Thurgar and R. A. Ward.
2812. C. Mohr and S. Smith.
2815. James Thorne.
2816. H. Sutherland and E. Sutherland.
2817. J. Keats and W. S. Clark.
2821. F. A. Papps.
2825. H. W. Ripley.
2828. Thomas Jones.
2829. P. A. le Comte de Fontainemoreau.
2831. G. Bell and R. Luthy.
2832. G. E. Noone.
2836. R. Harlow and W. Jolley.
2842. Michael Henry.
2848. Prosper Laches.
2850. James Bullough.
2851. Charles Vero.
2852. Arthur Wall.
2855. Thomas Restell.
2856. S. C. Kreeft.
2857. Richard Holiday.
2858. Marie Destrem.
2859. R. Allinson and H. Lea.
2862. Jules Aubin.
2868. W. E. Newton.
2871. Thomas Rowatt, jun.
2872. J. H. Johnson.
2874. Henry Wilson.
2875. Henry Wilson.
2876. A. G. Hunter
2879. William Snell.
2882. T. A. Blakely.
2883. A. A. Croll.
2884. Michael Henry.
2887. William Wilson.
2888. James Petrie.
2891. Joseph Phillips.
2899. J. Macintosh and A. H. Thurgar.
2901. W. E. Newton.
2902. William Martin.
2905. Stephen Bourne.
2910. Gustav Kottgen.
2911. H. L. Maquet.
2912. Jacob Snider, jun.
2913. William Ibotson.
2914. P. E. Gay.
2917. Robert Morrison.
2918. T. M. Brisbane.
2920. G. M. de Bayelt and J. E. Vigouléte.
2921. Peter Garnett.
2922. J Paley and T. Rawsthorne.
2923. Francis Mellus.
2924. Strother Price.
2925. German Prioleau.
2926. J. S. Gisborne.
2930. George Brunton.
2932. John Kassack.
2933. J. Eastwood and W. Wadsworth.
2937. John White.
2941. P. E. Gayfe and E. Zglinicki.
2942. Edward Cottam.
2946. William Ward.
2948. Louis Leisler.
2949. John Grundy.
2951. Charles Reeves.
2955. C. Hartley and T. Hall.
2960. Thomas Greenhough.
2968. W. Jackson and W. Glaholm.
2969. M. A. F. Mennons.
2975. George Davies.
2979. A. V. Newton.
2993. John Soper.
3000. F. C. Reim.
3026. William Clark.
3028. W. E. Newton.
3043. W. J. Burgess.
3049. A. D. Hall.
3056. Henry Wilson.
3061. A. V. Newton.
3073. John Ramsbottom.
3081. W. B. Adams.
3096. Herbert Taylor.
3111. P. A. le Comte de Fontainemoreau.
3115. William Bardwell.
3116. John Ellis.
3160. Henry Bird.
3174. William Reid.
3205. A. V. Newton.
3225. J. and W. Thornton.
3238. J. H. Johnson.
3231. H. and E. Sutherland.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

Holden ... ying animal charcoal.

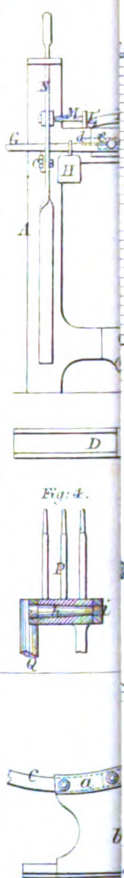
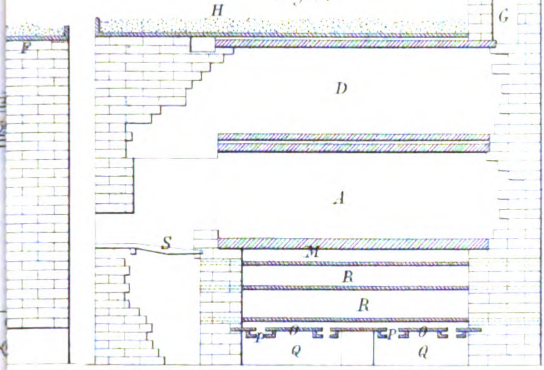
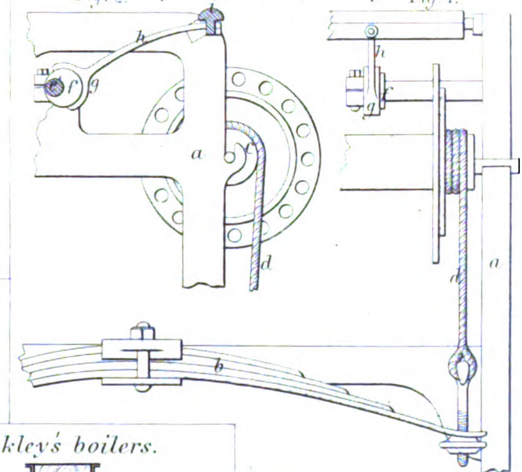


Fig: 3.

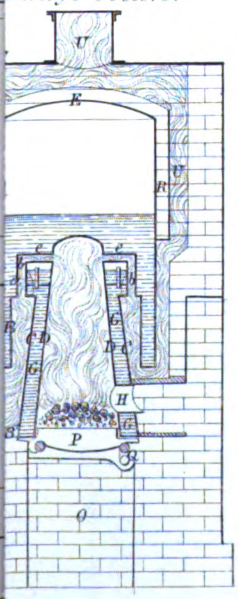


Openshaw's weaving.

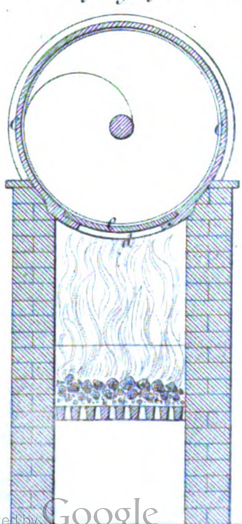
Fig: 2. Fig: 1.



...akley's boilers.



Wood's drying cylinders.



Newton & Son, delt. C. Pilling, lith.

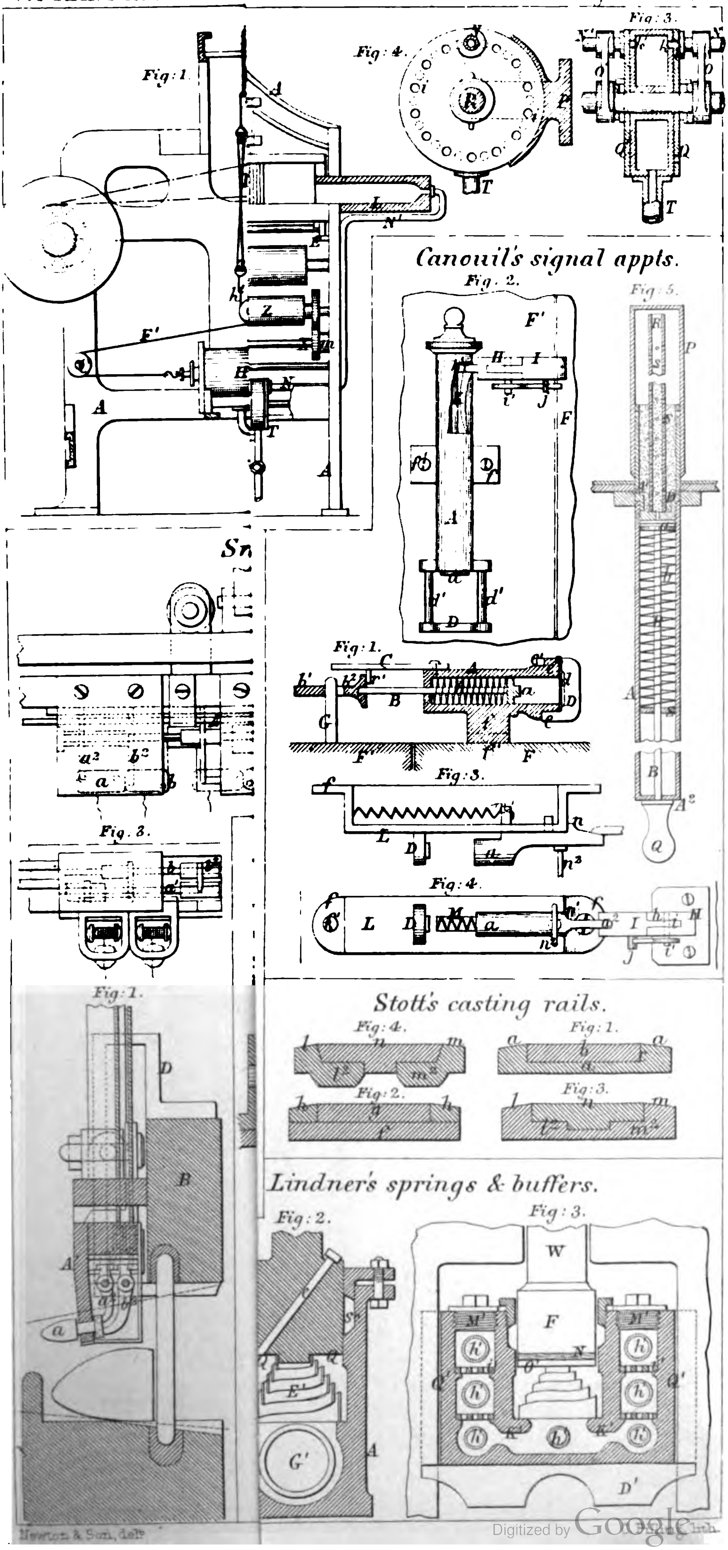
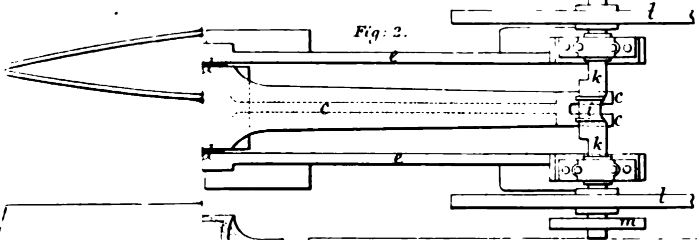


Fig: 1.
Fig: 4.
Fig: 3.
Canouil's signal appts.
Fig. 2.
Fig: 5.
Fig: 1.
Fig: 3.
Fig: 4.
Fig. 3.
Stott's casting rails.
Fig: 4.
Fig: 1.
Fig: 2.
Fig: 3.
Lindner's springs & buffers.
Fig: 2.
Fig: 3.
Fig: 1.
Newton & Son, delt

ith & Robert's breaking stone.

Fig: 2.



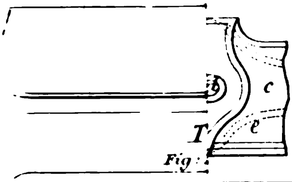
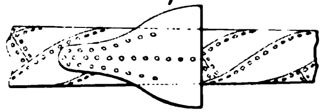
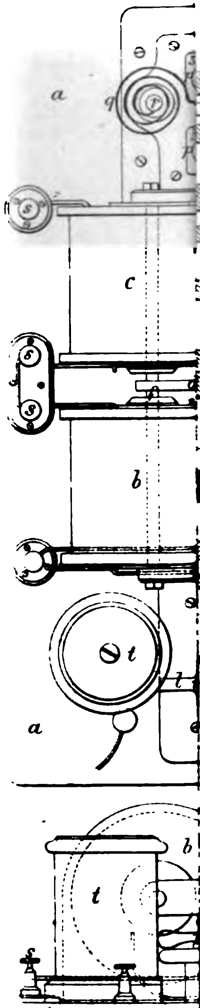


Fig:

Elwell's ship's masts.





Barlow's slide valves.

Fig: 1.

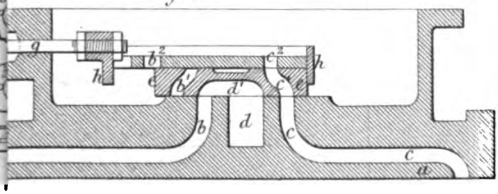


Fig: 2.

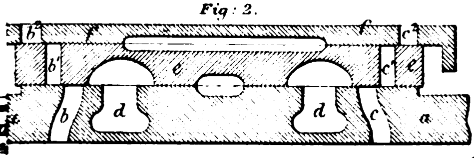
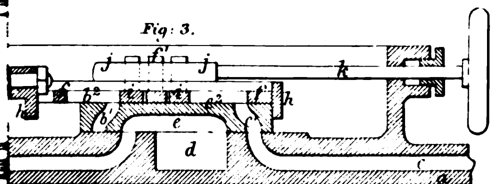
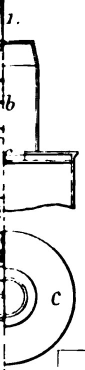


Fig: 3.



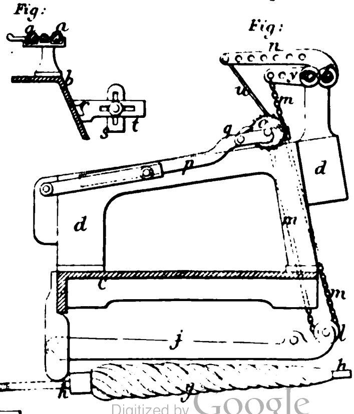
ler flasks.



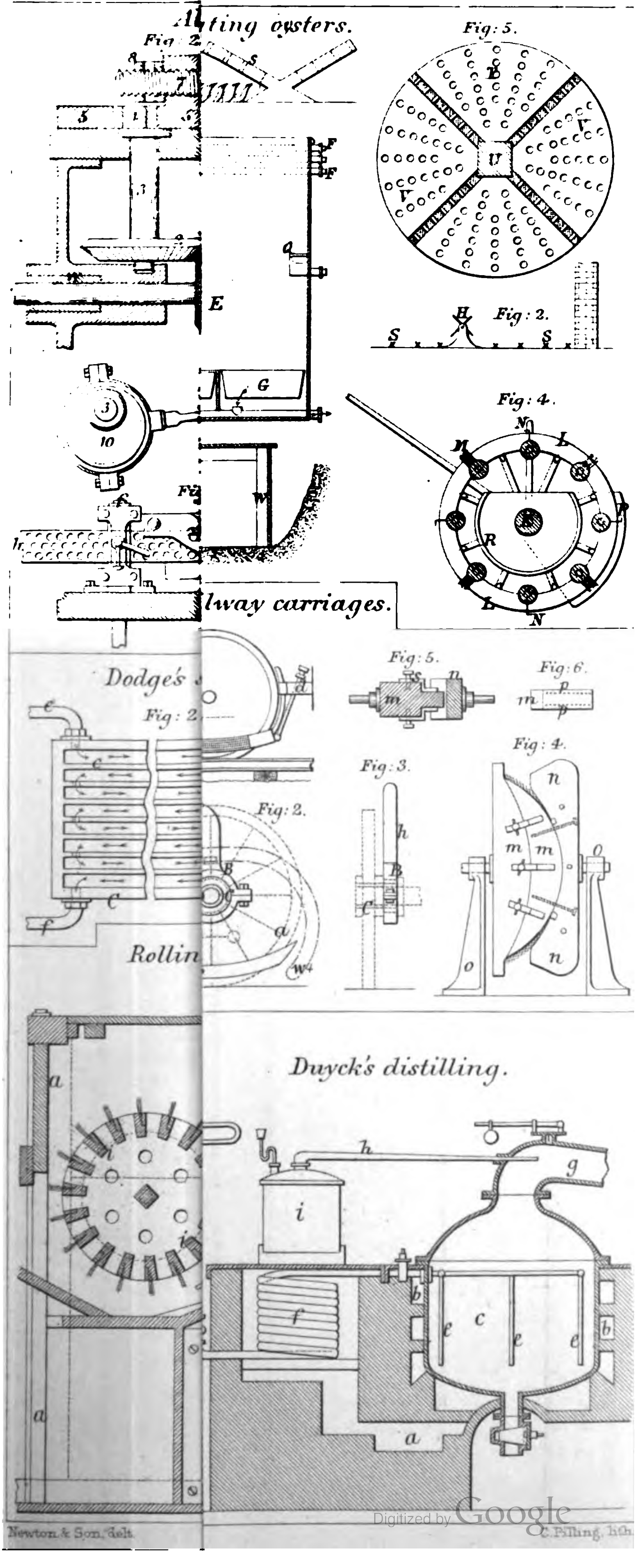
Standeven's spinning.

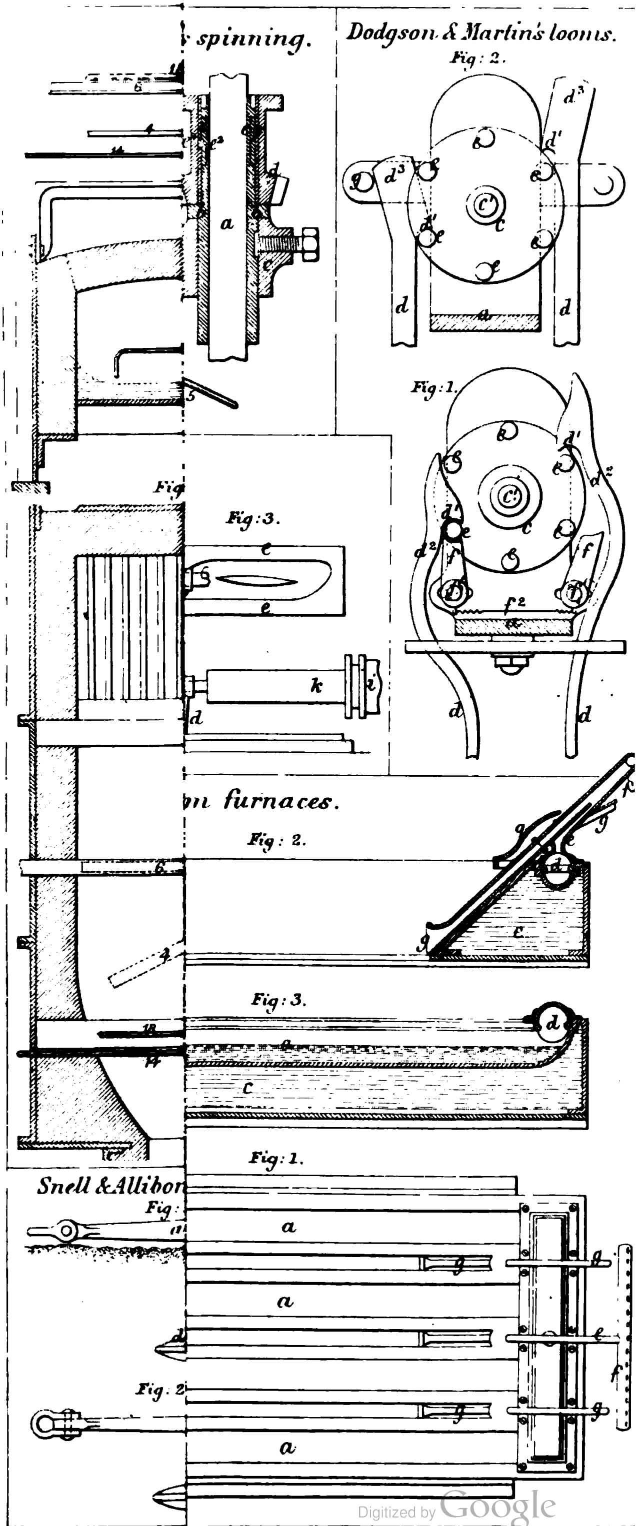
Fig:

Fig:

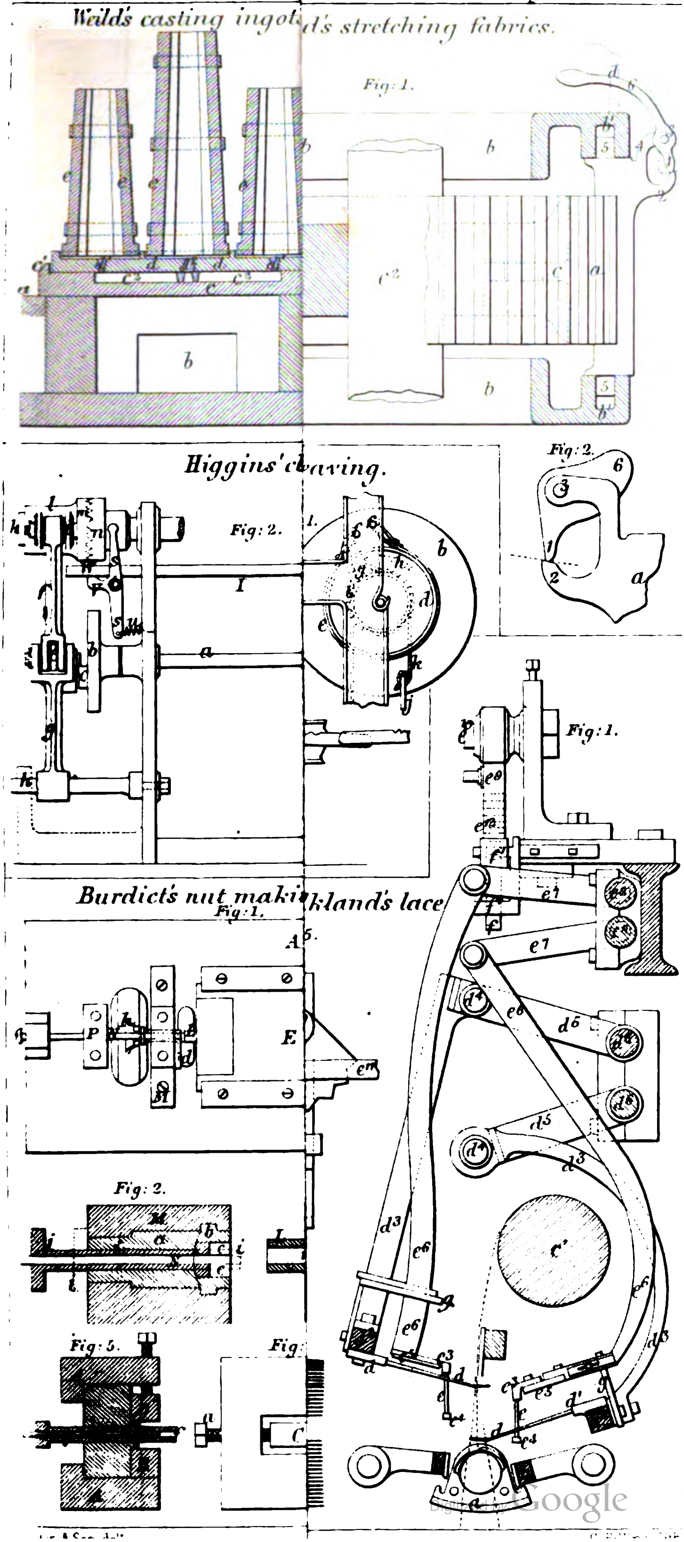


& Son, del. C Pilling lith.

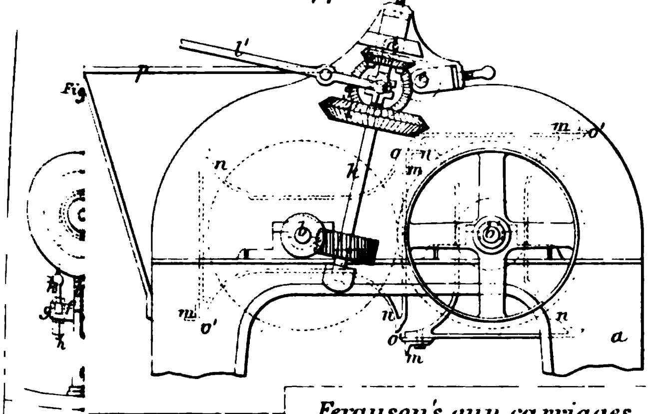

...ting oysters.
Fig: 2.
Fig: 5.
Fig: 2.
Fig: 4.
...lway carriages.
Dodge's ...
Fig: 2.
Fig: 5.
Fig: 6.
Fig: 2.
Fig: 3.
Fig: 4.
Rollin...
Duyck's distilling.
Newton & Son, delt
C. Pilling, lith.



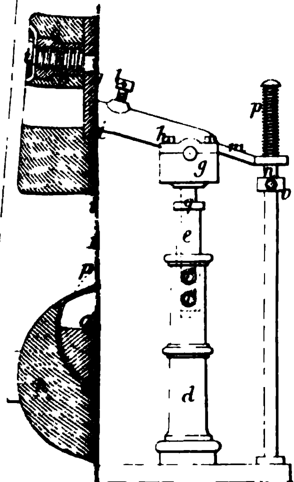
Newton & Son delt C. Pilling lith.


Weild's casting ingot
d's stretching fabrics.
Fig: 1.
Higgins' cleaving.
Fig: 2.
Fig: 2.
Fig: 1.
Burdict's nut maki
Fig: 1.
kland's lace
Fig: 2.
Fig: 5.
Fig:

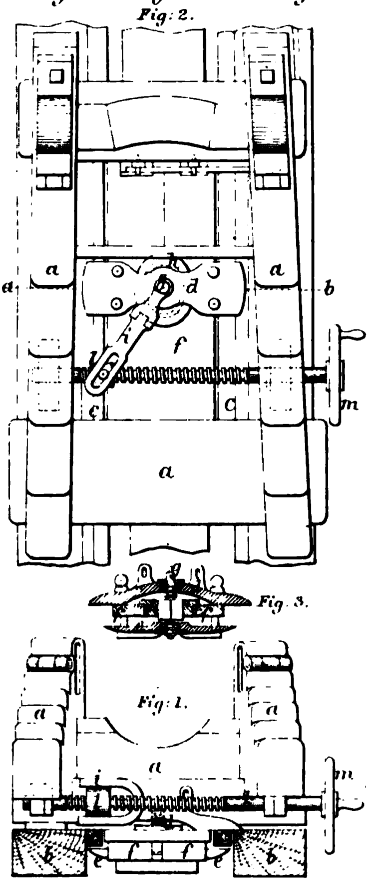
Nevin & Coppin's flax breaker.



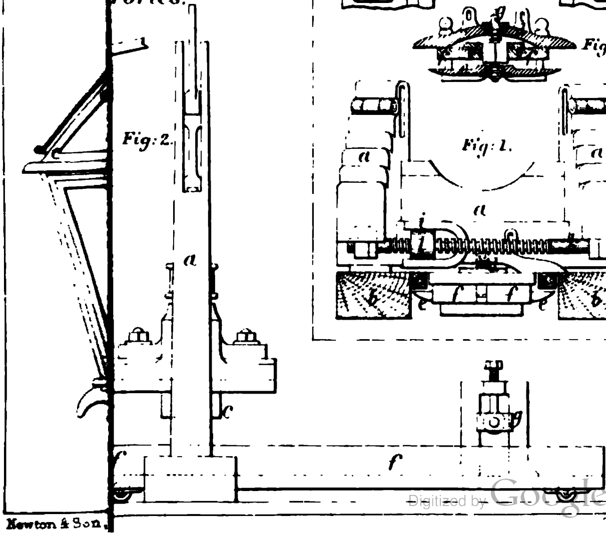
...netals.



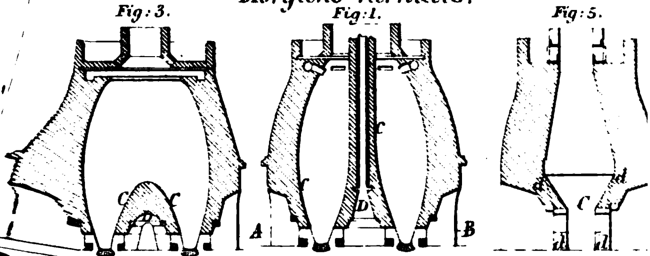
Ferguson's gun carriages.

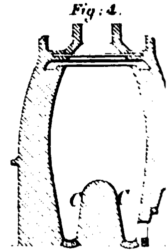


Bro... ...brics.

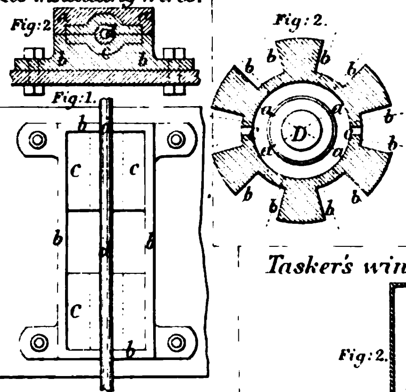


Morgan's furnaces.

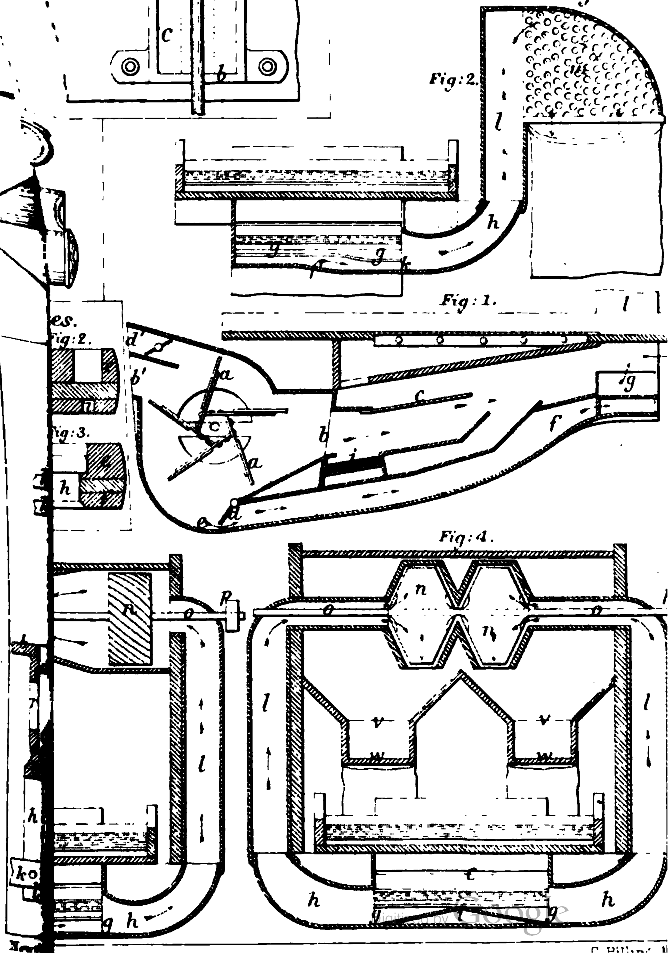




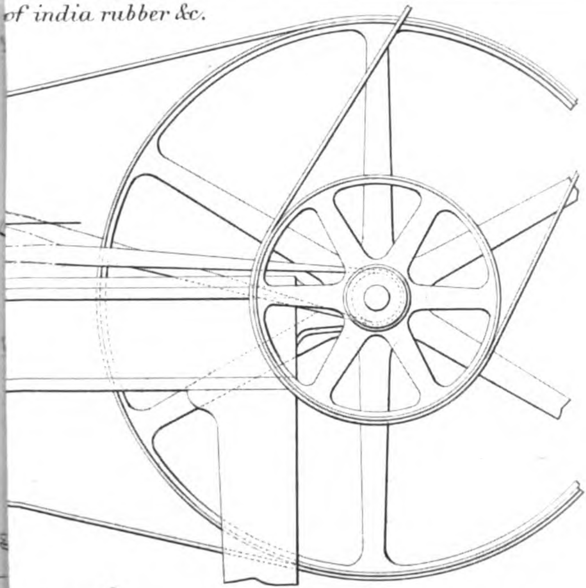
Reid's insulating wires.

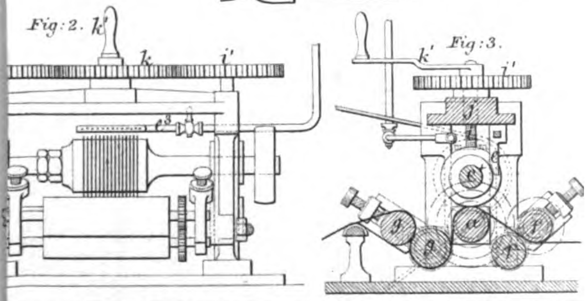


Tasker's winnowing &c.

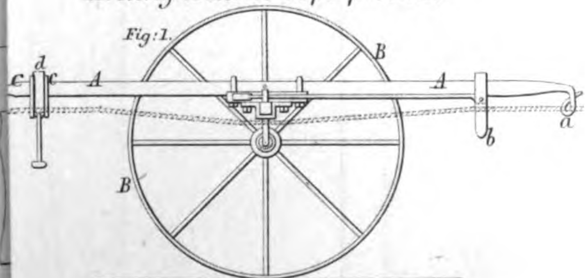


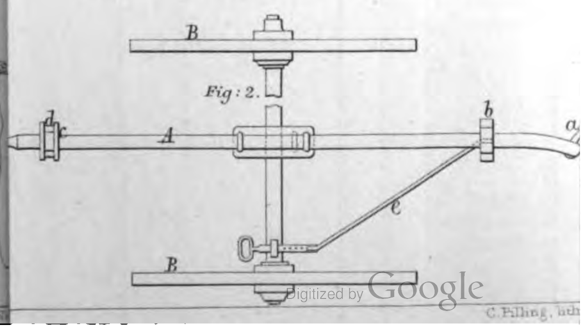
of india rubber &c.



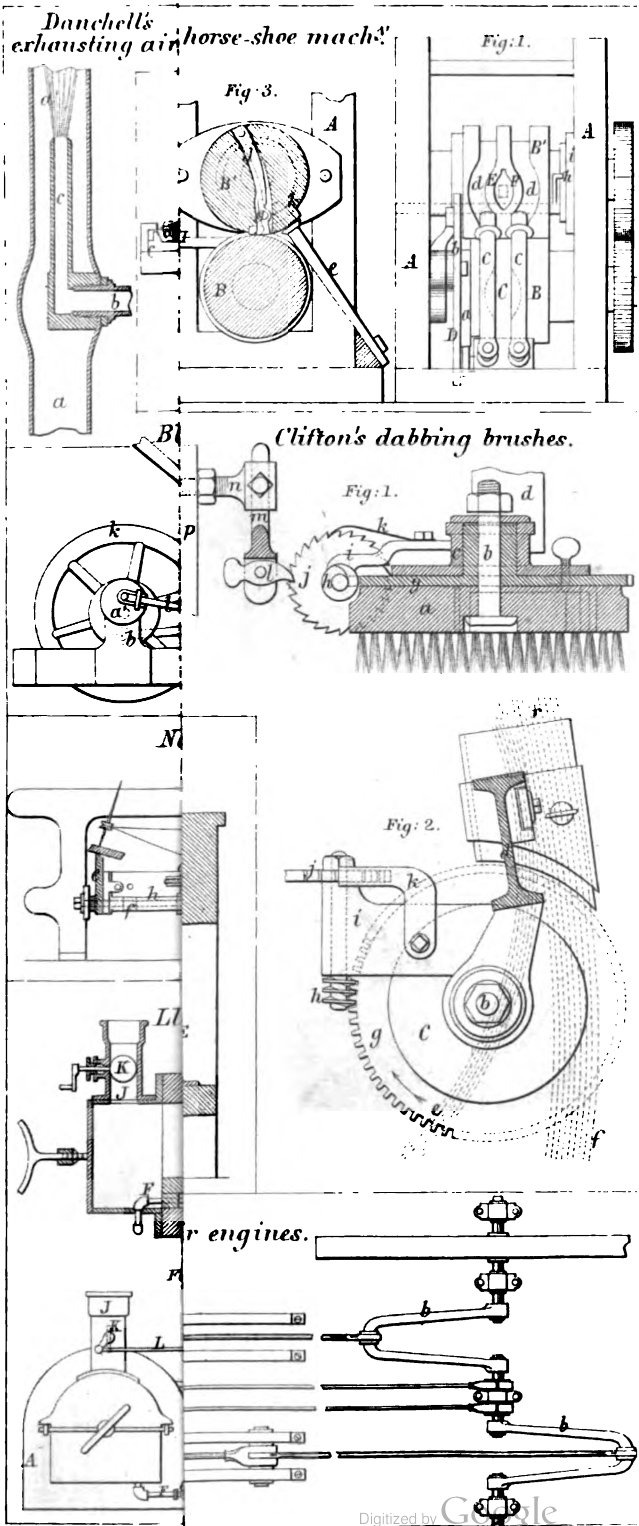


Aveling & Lake's rope porters.



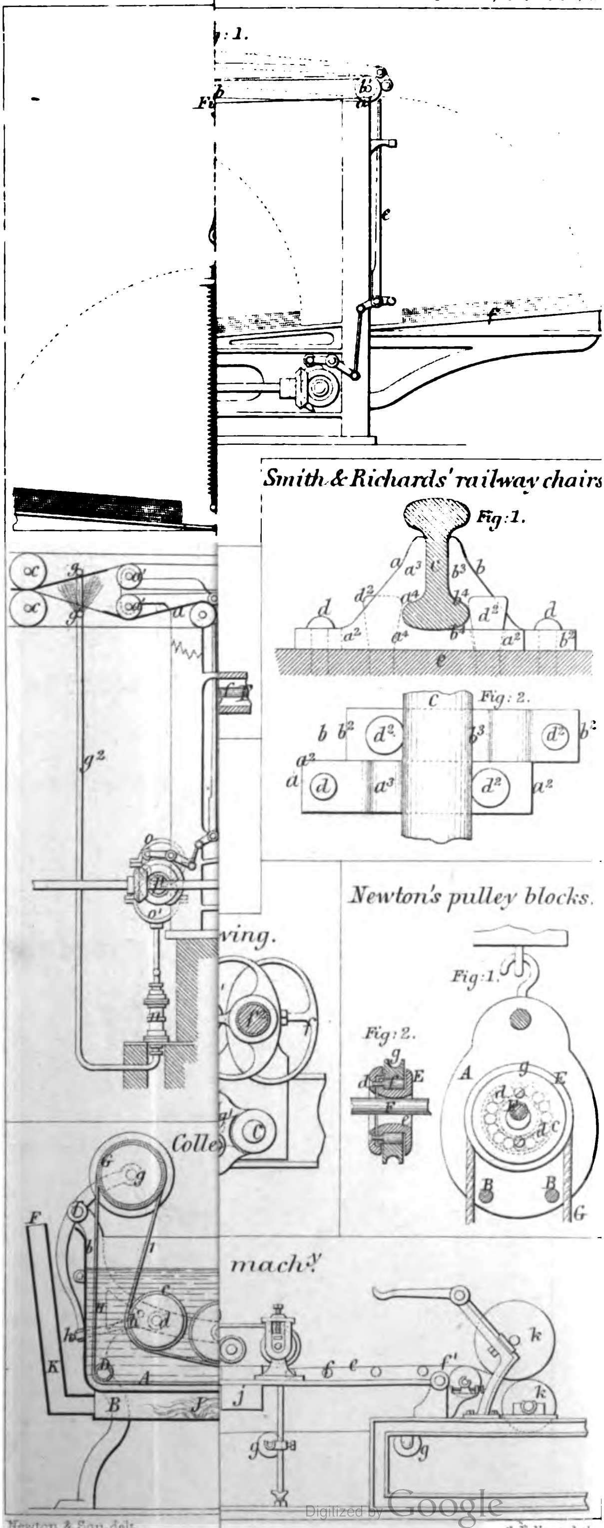


C. Pilling, lith



Newton & Son, delt

C.Pilling, lith.



Newton & Son, del.

NEWTON'S

LONDON JOURNAL

OF

Arts and Sciences;

BEING

A RECORD OF THE PROGRESS OF INVENTION AS APPLIED TO THE ARTS.

[ESTABLISHED IN THE YEAR 1820.]

NEW SERIES.

VOL. XXII.

London:

PUBLISHED BY NEWTON AND SON, AT THE OFFICE FOR PATENTS, 66 CHANCERY LANE;
KENT AND CO., PATERNOSTER ROW; SIMPKIN, MARSHALL, AND CO.,
STATIONERS' COURT; AND C. S. FRANCIS AND CO., BROADWAY,
NEW YORK; AND LUDWIG DENICKE, LEIPZIG.

1865.

FOLKARD AND SON, PRINTERS,
DEVONSHIRE STREET, QUEEN SQUARE,
BLOOMSBURY.

LIST OF PLATES IN VOL. XXII.

[NEW SERIES.]

INDEX TO VOL. XXII.

[NEW SERIES.]

PATENTS, REPORTS OF RECENT.

NEWTON'S

London Journal of Arts and Sciences.

No. CXXVII. (NEW SERIES), July 1st, 1865.

FACTORY LABOUR.

When contemplating, as we are frequently invited to do, the vast pecuniary resources of Great Britain, as illustrated by the quarterly returns made by order of Parliament of the national income,—which seems to increase under every pruning operation of the present Chancellor of the Exchequer,—we are wont to express unmitigated satisfaction at the result, as if there could be but one opinion that here is an irresistible proof of national prosperity. No doubt this state of things is very pleasing to the Government, and it is by no means unsatisfactory to commercial men; but it is not quite so certain that the philanthropist can unhesitatingly receive it as a reliable evidence of national prosperity. It must at once be admitted to be a proof of national activity; but the two expressions have a vastly different meaning, although they are not uncommonly used indifferently. We have been occasionally startled by the publication of facts connected with industrial occupations, showing such a debasement of humanity as we had expected to find only among savage nations; and parliamentary aid has then been obtained to remedy the evil. It is now, however, only too evident, that so great is the force of competition in mercantile pursuits, that self-seekers, whether masters or workmen, in all branches of industry require the power of the law to restrain them within reasonable bounds. The half-yearly revelations of the Inspectors of Factories are a continual comment on this text. Their duties were, as is well known, originally confined to the enforcing of certain regulations enacted for the benefit of the workers in the cotton and other textile factories, and the advantages which these regulations conferred on all concerned led from time to time to their extension to other branches of trade. By recent enactments, some trades, whose origin date back less than thirty years, are now brought under inspection; and others of older standing are for the first time subjected to legal regulations. Slowly we are moving on in the right direction; but the last report of the Inspectors furnishes proof the most lamentable of the necessity of a still further extension of the Factory Acts. This course seems to

be the only effectual remedy for the brutal selfishness which obtains in active trades which are free from inspection. The introduction of the Factories Acts, or some modification of them, affords, moreover, a plea for enforcing education upon the young,—a duty which is wisely acknowledged as a national one in many countries, but which our respect for parental authority will not allow us to enforce. To show the bearing of parental authority in certain sections of the labouring class, we will extract a passage or two from Mr. Baker's report, which embodies the very curious evidence of a brickmaker on the state of his trade. After lamenting the invasion of ignorance among the children occupied in the clay fields, and urging the limitation of their hours of labour in order that they may acquire an elementary schooling suited to their position in life, this master says: "I have known parents in receipt of two, three, and four pounds a week send their children out to work at clay works for a few shillings per week, hung in rags, whilst the parents themselves rioted at home in luxuries and drink." This is one of the branches of trade as yet free from legislative interference. Of this highly favoured trade, Mr. Baker himself says:—"Children of very early years are sent to the clay yard, and are brought up amid scenes and conversations which are most demoralizing. One may, in fact, scarcely recognize, either in the person or the mind and manner of the female clay-worker, a feature of the sex to which she belongs. I have seen a boy of five years old working among two or three-and-twenty females, being 'broken in,' as they call it, to the labour." It may be that this field of labour is not yet deemed ripe for legislation; but certain it is that vice and industry, such as this report indicates, cannot much longer flourish together.

We have recently taken credit for the artistic improvement discernible in English pottery; and the large foreign demand evidenced by our export tables proves that this trade forms no unimportant item of the national wealth. But from its growth does the prosperity of the workman necessarily follow? Let us refer again to the Inspectors' reports,—earthenware works, including china and stoneware, having recently been placed under their rule. Mr. Baker, writing of the potters, says:—"Saint Monday has hitherto been a very patron amongst them, and is by some absolutely idolized. On his day occur all the weekly rabbit races, dog races, and hop-step-and-jump matches for sums which to an agricultural labourer would be a year's maintenance for his whole family. If they hire at Martinmas, an old-fashioned condition of labour which is still retained in the potteries, they 'wet the bargain' till it is drenched through and through. If there is a 'wake' they keep it for a week. In short, whatever can be converted into an excuse for a break off is adopted as a matter of

course." As a result of all this we are not surprised to find that "rags and comfortless homes stand everywhere in prominent relief in many of the wealthiest districts both of North and South Staffordshire, where the wages of the family often amount to £3, £4, and £5 a week. I have been told of an instance in South Staffordshire where the family wages were as high as £6 a week, and where a prepayment of them was necessary, in consequence of extravagance, before the Saturday night."

But it will be asked—How are such high wages possible with such dissolute habits? That they were possible, we will presently show; but, thanks to the Act which has brought this trade under supervision, they will, for the future, be impossible. The workman must, therefore, reform, or the manufacture will diminish, for his hours of work will be prescribed, and what he wastes he will not be able to make good. Mr. Redgrave tells us that the operative contracts to make certain articles of earthenware at a certain price; he is entirely his own master as to his time, and the number of persons whom he may employ to assist him; he generally begins late and works late. A boy, or, it may be, a woman, turns the wheel upon which the potter forms the ware. He also employs children for "wedging" the clay—that is, expelling the air from the kneaded and mixed clay, and also for "batting," or shaping the clay for his use. "A piece of clay," says Mr. Redgrave, "weighing generally 70 lbs., is brought to the potter's shop from the place where it was mixed, by a child or female, one of the assistants to the potter; it is placed upon a slab of stone, and the 'wedger'—the same child or female—then cuts off a slice with a piece of string, the slice being as large as the wedger can lift; he then takes the slice in both hands, raises the hands as high as possible above the head, and dashes the slice, with as much impetus as he is capable of, upon the piece of clay left upon the slab. The force drives out the air, and the operation is continued until the clay is free from air." This our informant had seen done both before the potter sets to work, and during his meal times, that he might not have to wait for clay; and, to complete the picture, we are further told that, "while the man smoked his pipe at his ease, the child was hard at work; and the length of the child's working day was much beyond that of the man." We have thus the key to an objection that was urged by the potters against one of Mr. Baker's rules, which prohibited smoking in the workrooms during working hours, their complaint being that "it was an arbitrary interference with their rights," as slave-drivers, we presume, to sit at ease and see the heaviest part of their work performed at a nominal remuneration, and generally by members of their own family. What the average pay of these children or females is, we are not informed; but, in a kindred business—brickmaking—the master, whose evidence we

have already quoted, says that the elder clay carriers, who are usually girls between 14 and 16 years of age, "as a fair average, carry 9 tons of clay 50 yards, and walk 22 miles, to earn a day's wage, amounting to, and not exceeding, 1s. 6d." It is time that England ceased to get wealth and fame from manufactures produced at such sacrifices as we have thus hastily sketched.

Another branch of trade which is now happily placed under the regulations of the Factory Acts by the Act of 1864, is the manufacture of lucifer matches. This business, besides the risk of fire to which it is constantly liable, induces a frightful malady known as the "jaw disease," to which the dippers, or those who coat the ends of the matches with the ignitable compound, are very subject. It is, however, due to the large manufacturers to say, that they have earnestly striven, and at last with success, to remove the cause of this evil, viz., the inhalation of the poisonous fumes of the phosphorus used to tip the matches. The following lucid description, by Mr. Redgrave, will show the nature of the work which brings on this jaw disease, which is a wasting away of the jaw bone. He says:—"The splints of wood having been arranged in what are called 'clamps,' so that each splint of wood, from 1000 to 3000 in a clamp, should be separate, but the ends of the whole even, are handed to the 'dipper,' who stands over a heated stove or slab of iron, upon which the mixture of phosphorus is spread. He presses the ends of the splints of wood into the mixture, hands the clamp to a boy, who carries it to the drying place, the dipper receiving a fresh clamp from another assistant, and so on until he has completed his task. During this time a vapour continually rises from the heated mixture, which, as a general rule, the dipper inhales." This dipping operation, we are happy to say, is now, through the enterprise of Messrs. Bell and Black, the large lucifer match manufacturers at Bow-bridge, effected by an ingenious arrangement of automatic machinery. Mr. Redgrave describes it as "the most perfect arrangement for dipping which I have seen," the fumes, as they arise, being carried far away from the persons employed. We should be glad to have to record the introduction of automatic machinery into other trades injurious to health; for we are sure that ingenuity and enterprise alone are wanting to release our workmen from many unhealthy occupations connected with staple manufactures.

The manufacture of percussion caps and cartridges is another branch of industry which has recently been brought under the ken of the factory Inspector. It is a very restricted manufacture, and further than the dismissal of children, the extension to it of the Factories Act, appears to have had no effect upon it,—no objectionable practice in the carrying on of this very dangerous business, or systematic disregard of reasonable precautions having been detected.

In fustian cutting—which is the last trade we shall notice as having been placed under legal regulation—the inhumanity displayed by the employers of labour is remarkable. The work is undertaken by small masters, who obtain the woven goods from the manufacturers, and cut the pile of the velveteens and tabby velvets at contract prices. "Long hours and hard labour," says Mr. Redgrave, "are the characteristics of fustian cutting." Mr. Baker estimates the number of hands employed at this work in his district to be—males, 420; females, 1060; of which latter 200 are children. What numbers are employed in Mr. Redgrave's district we are not told; but he says enough of the nature of the work to convince the most sceptical of the necessity that existed for bringing it under the Factory Acts, and thereby removing from the trade the competition of infant labour. We cannot resist a long extract which gives a vivid picture of an important branch of industry, the growth of which we might, if not otherwise instructed, fairly enough take as an indication of national prosperity:—

"The following is the nature of the work to be done:—The cutting table is an oblong frame, about 8 feet long and 3 feet wide. The piece of goods to be cut is upon rollers at each end of the table, and is stretched taut. The cutter, who has a rapier-like knife, with a very sharp point, takes his place at the right-hand end of the table, inserts his knife in the outermost pile at the farther side of the piece of goods, and drives the knife along the series of piles to the end of the table. To enable him to reach to the end of the table, he has to step out with his left foot about a yard, and follow his right arm with his body; and, in the case of a child, the body has been brought so far down upon the left leg, that a considerable jerk is necessary to enable the child to recover its position upon its right leg, at the right-hand end of the table, to be ready to insert the knife into the next series of piles. The occupation only need be broken twice: either when the knife requires to be sharpened, which is done by the overlooker, or again when the length of fustian has been cut, and has to be rolled up, so as to stretch another length of uncut pile.

"Each piece of velvet contains 900 races of pile in width, and the knife has consequently to make 900 cuts from end to end of the frame on each length of the fustian; and as nine lengths are considered a day's work, it follows that the knife is passed daily over a space of about 10 miles, and the child has to make 8100 passes of the knife, or, reckoning the child worked ten hours and a-half per day, and allowing half an hour for intervals of the fustian cutting, sharpening the knife, and adjusting the lengths of fustian upon the table, it would cut 13 races per minute, thrusting the body forwards and backwards the same number of times.

"But the hardship of this kind of labour is more striking, when it appears that the actual work of the adult fustian cutters is less than that of the children. The men usually cut velveteens, which contain only 750 races, and they are only expected to cut the same number of lengths as the children, viz., nine; and thus they will make only 6780 passes of the knife, or rather more than eight miles per day."

We may well regret, with Mr. Baker, "that though many thousands of pounds have been wasted upon experiments, as yet it has not been possible to supersede the present mode of cutting by machinery." Here is, then, a field open to the inventor, which, while it yields to the successful man a handsome pecuniary return, will enable him to release from bondage a class who are total strangers to the amenities of civilised life. While, however, we may look forward confidently to the gradual absorption by automatic machinery of industrial occupations involving—like the wedging and batting of clay, and fustian cutting—a continuous physical strain, or, as in the case of lucifer match making, the inhalation of noxious fumes, we must have read in vain the Inspectors' reports if we do not conclude, with them, that "free labour (if so it may be termed), even in a free country, requires the strong arm of the law to protect it from the cupidity and ignorance of parents—to enforce a leisure which philanthropy may adopt and employ when parental feeling fails, in order that the youthful labourer may be instructed in those various duties of life which form its great social charm, and are but the footsteps of religious and intellectual advancement."

Recent Patents.

To WILLIAM CLARK, *of Chancery-lane, for improvements in the means of producing ornamentation on porcelain, glass, metal, and other surfaces,—being a communication.*—[Dated 9th August, 1864.]

THIS invention consists, 1st, in producing varied designs or crystalline ornamentation on all kinds of polished surfaces, such as glass, porcelain, metals, or others, by the application thereon, in a cold state, of saline solutions or other crystallizable matters, either alone or combined with amorphous insoluble substances held in suspension, and in facilitating the formation of large crystalline configurations by thickening the concentrated solutions with gum, dextrine, or gelatine, the two former being the most suitable for the purpose. Any solid matter may be held in suspension in these solutions, including mineral colours, coloured enamels, or others, provided they are finely pulverised, or in the form of hydrates; other liquids, such as alcohol, for example, may also serve as a solvent. Similar abnormal crystallizations may also be obtained with water in which the above solid matters have been diluted, which are then frosted in thin layers. By the slow evaporation of the water, the solid matters will remain deposited on the glass or metal while retaining their crystalline arrangement, and may be fixed or reproduced by the processes hereinafter indicated in the course of the present description.

The invention consists, 2ndly, in protecting, fixing, and preserving these designs produced by crystallization in the manner described from the action of water or friction by means of mastic or other varnish, or collodion, which designs are afterwards fixed by exposure to a sufficiently high temperature to vitrify the saline combinations obtained by crystallization.

3rdly, in chemically transforming the bodies so disposed in crystallized sheets by means of various reactions; for example, these bodies may be transformed into sulphurets by exposing them to the vapours of hydrosulphate of ammonia, which become decomposed thereby; in the same manner, sulphate of copper may be employed, which will produce sulphuret of copper, serving to preserve the crystalline properties of the sulphate.

4thly, in reproducing copper plates (stereotypes) by the aid of photography, engraving, and galvanoplasty, moulding by means of gutta percha, or precipitation by the galvanoplastic process; these stereotype plates of copper may also be produced by simple pressure between rollers, or in hydraulic presses by the compression of sheets of iron, steel, or German silver, having the crystalline designs applied thereon against sheets of annealed copper, which latter will serve for printing papers, fabrics, leather, and other substances. In order to obtain continuous designs suitable for paper hangings and fabrics, the original designs are produced on rollers of cast iron or steel, and transferred by pressure on to plates or rollers of annealed copper or other soft metal, the latter serving for impressing or producing plates or rollers with designs in relief. The designs, as applied on paper for the production of bank notes, especially when printing with blue ink on paper with a yellowish ground, would prevent the possibility of forgery.

5thly, in the application of the above-described methods for fixing and producing frosted designs on glass or metallic plates, the operations being effected at very low temperatures. Frosted designs produced on steel plates at a temperature not lower than about 23° Fahr. may be produced concave in lead, or annealed copper, by means of rollers, and then reproduced by direct impression or by the produc- of relief plates. The designs on metal plates, with solid bodies, disposed in the form of crystals by freezing water, may be produced in a similar manner after the slow evaporation of the water, and if these bodies consist in vitrifiable enamels, they may be fixed by means of heat.

6thly, the invention consists in producing coloured crystalline designs, either by applying colour on the glass, by fixing the design by means of coloured varnish; or, lastly, by an alcoholic solution of fuschine or other derivative of aniline, or suitable colour.

7thly, in the reproduction of the crystalline designs on sheets of copper, by engraving with aquafortis, on steel by engraving with hydrofluoric acid, and on glass by forming reserves on said sheets, having the crystalline designs produced in the manner already described with a resinous alcoholic solution. These reserves preserve the surface from the action of the acid, taking effect at all points not occupied by the crystals, which may be readily ascertained on washing with water, when the crystals in question become dissolved. The resinous solution above-mentioned is obtained by dissolving one part of gum lac in six to eight parts of alcohol, containing 90 to 95 per cent. of spirit. If the design is on metal, the resinous varnish is applied, and, after drying, washed with water, which removes the soluble parts, and leaves a resinous negative; an engraving may then be produced by the action of the nitric acid on the denuded parts. If the design be on glass instead of metal, the method is the same, with the exception that, instead of nitric acid, hydrofluoric acid is employed. In

order to produce abnormal crystallisations on glass or porcelain, it is simply necessary to expose the sheet of glass or porcelain objects coated with the crystals to the action of the vapours of hydrofluoric acid; in this manner the access of the vapours to the surface of the glass or porcelain is more or less retarded by the inequalities in the thickness of the crystallisations, all the details being thus perfectly reproduced.

8thly, the invention consists in an improved method of engraving on glass by the aid of hydrofluoric acid, displacing said acid from its combination with certain fluorides insoluble in water by means of gaseous sulphuric acid, or preferably liquid concentrated sulphuric acid. The fluorides in question are applied on the glass during the formation of the crystalline designs, as before described, or they may be applied with a brush, or by transfer from an impression on paper. For engraving on glass in this manner fluorides of copper and zinc give the best results. It is sufficient to simply immerse the sheets of glass covered with the crystalline designs (produced by the deposit of fluorides of copper, or it may be the same fluoride applied with a brush and a little gum water, by the aid of hard brushes and plates of copper having the designs cut out, or, lastly, by transfer), in the sulphuric acid for several hours; thus a very perfect engraving may be produced.

This improved process is also suitable for engraving on porcelain as well as glass, the silvering and gilding processes being also applicable.

The patentee claims, " First,—the production of ornamenal designs similar to the frosting of window glass, but varied in arrangement by means of solutions of crystallisable matters, applied in thin layers on suitable polished surfaces. Secondly,—fixing the designs by means of varnish collodion, or more effectually by vitrification, in cases where enamels are employed in the crystallisations. Thirdly,—employing vitrification as a means of fixing the frosted designs in which enamels or vitrifiable matters have been introduced after being diluted in water, and applied to thin layers on the glass, to be afterwards submitted to a freezing process, in the manner described. Fourthly,—reproducing crystalline designs with crystallisable solutions, saline, or otherwise, and also frosted designs, by the aid of photography or galvanoplasty, and by pressing the crystalline designs on sheets of copper, the operation in the case of frosting being effected at low temperatures. Lastly, under this head of the invention, the reproduction of designs, frosted or otherwise, on paper or fabrics with copper plates, obtained in the manner described. Fifthly,—applying these impressions for the manufacture of bank note and other similar paper. Sixthly,—reproducing, by means of engraving, the crystalline or other designs produced on glass, with a brush by transfer from the crystallisations, or by the application with a brush of metallic fluorides, and particularly those of copper and zinc, said designs being submitted to the action of hydrosulphuric gas, or preferably to that of concentrated sulphuric acid. Seventhly,—reproducing these crystalline designs on porcelain or glass, by exposing the articles so covered with the designs to the action of the vapours of hydrofluoric acid. The articles engraved according to these two methods may be afterwards gilt or silvered in the ordinary way of silvering looking-glasses."

To Colin Mather, *of Manchester, for improvements in mandrils for printing rollers.*—[Dated 6th February, 1864.]

This invention consists in making the mandril of printing rollers near one of its ends with a taper or cone upon it, and the engraved copper cylinder is, at its ends, also made taper interiorly, so that when it is slid on to the mandril, it is able to pass along it until the cone on the mandril enters and fits into the conical mouth of the cylinder.

The fig. in Plate I. shows a mandril and printing cylinder or shell constructed and combined according to this invention. *a*, is the mandril, which at one end is made to fit the enlarged conical end of the printing cylinder or shell, on which end of the mandril is formed a screw to receive a screw nut *f*. The other end of the mandril is turned down to receive a ring or bushing *b*, which is split longitudinally at *d*, leaving a space between the two edges by which the ring or bushing *b*, can to some extent collapse. The external surface of the ring or bushing *b*, is conical, and it is forced into the conical end of the cylinder. At that end of the mandril where the ring *b*, is applied, there is a screw formed on the mandril to receive a nut *c*. By screwing up this nut, the ring *b*, is forced along the portion of the mandril which is reduced in diameter and within the conical end of the cylinder. On the outer surface, and at the outer end of the ring, is formed a screw to receive the screw nut *e*, the screwing up of which will tend to force the ring out of the end of the cylinder. The ring *b*, has grooves longitudinally in its outer surface which enable it to bend more easily round the mandril. When it is desired to remove the cylinder from the mandril, the nut *c*, is to be unscrewed; then, by screwing up the nut *e*, which rests against the end of the cylinder, the ring *b*, will be moved outwards from the end of the cylinder till it is loose; and, in order completely to remove the cylinder from the mandril, the screw nut *f*, is to be turned, which, pressing against the other end of the printing cylinder, will force it along the mandril. In some instances the sliding ring *b*, is used at both ends of the mandril, instead of having one of the conical parts a part of the mandril itself. In this case, the two ends of the mandril are precisely alike, the screws which are cut on it being right and left-handed, so that any friction the nuts may get from the steps or bearings in the sides of the machine may have a tendency to tighten up both nuts.

The patentee claims, "the combined arrangement of parts herein described."

To Samuel Bateman, *of Bradford, Yorkshire, for improvements in paddle wheels of steamboats.*—[Dated 27th April, 1864.]

This invention is illustrated in Plate II., where fig. 1 represents the improved paddle wheel in side elevation. The paddle wheel is constructed in the same manner as those hitherto employed, except, however, that instead of having the paddles fixed permanently on the same shaft, they are caused to move in guides *a*, fixed on the arms of the paddles. On each side of the paddle wheel an excentric *b*, is set, in

which a groove c, is formed to receive and guide pins from the paddles. The shaft of the wheel turns freely in the excentrics. When the wheel rotates, the paddles being maintained in a radial position with respect to the shaft, they follow a movement from fore to aft; therefore, when they have arrived at the end of their range—that is to say, at the moment they meet with the water—the arm of the lever c^*, is shortened of half of its length, whilst the opposite lever d^*, is increased of that length. "By this means a superior force is acted as soon as the paddle reaches the water, and the back water resistance is of course lessened on account of the lever being shortened as it rises out of the water."

Fig. 2 is a side elevation of a modification of the improvement in the construction of paddle wheels, in which each arm of the lever, the number of which is eight, carries with it a paddle, and is jointed to a cranked shaft a, provided with a coiled spring. The cranked shaft a, carries on one side a cog wheel b, gearing with a cam c, and this cam is provided at its lower part with two cogs d, and an excentric part e, serving to maintain the paddle in the position it has received from the rotative motion—that is to say, nearer the centre; but when the paddle has passed over that excentric part and returned in the water, it draws back to its longest position to give the impulse to the boat. The paddles work in a slide, to avoid the resistance during the rotative movement of the cranked arms.

The patentee claims, "the general construction of the mechanism as described, for the purpose of doing away with the resistance of the back water."

To WILLIAM ROWAN, *of Belfast, for improvements in machinery for treating flax and other vegetable fibres and tow.*—[Dated 17th May, 1864.]

THESE improvements in machinery for treating flax and other vegetable fibres in the straw, consist in arranging pairs of crushing rollers through which the straw passes in succession; each pair of upper rollers being separately weighted, and the pairs of top and bottom rollers being driven at gradually increasing speeds, as hereinafter more fully described.

In Plate I., fig. 1 is a side elevation of the improved machine, and fig. 2 is a section through the line a, b. Six pairs of fluted rollers are employed for breaking the flax straw, of which the second pair is driven at a greater speed than the first pair; the third pair at a greater speed than the second pair, and so on, each succeeding pair being driven at a greater speed than the pair immediately preceding. The differences in speed are determined by the varying diameters of the toothed wheels g, g, g, which receive their motion from the wheel h, and intermediate wheels h^1; the wheel h, is in gear, with a wheel i, carried by a shaft j, on which the driving pulleys k, are mounted. The wheels g, g, g, drive the lower fluted rollers, which carry at their other ends toothed wheels g^1, g^1, in gear with other toothed wheels g^2, on the upper fluted rollers. Each pair of upper fluted rollers is separately weighted by weights l, l, suspended from bars m, m, to which vertical

rods *n*, *n*, are connected. The rods *n*, *n*, are suspended from cross heads *o*, *o*, which bear upon the journals of the upper fluted rollers. The lower fluted rollers are not weighted; *p* is the table, to which the flax straw or other material for feeding the fluted rollers is supplied.

The patentee claims, "First—constructing machinery for treating flax and other vegetable fibres and tow with rollers, through which the fibre or tow passes in succession, each pair of upper rollers being separately weighted, in manner described. Secondly—constructing machinery for treating flax and other vegetable fibres and tow with rollers, through which the fibre or tow passes, each pair of top and bottom rollers being driven at a greater speed than the pair immediately preceding it, in manner described.

To JAMES BROWN, *of Aldgate, and* JOHN THOMAS WAY *and* THOMAS MULLETT EVANS, *both of Leadenhall-street, for improvements in sheathing ships.*—[Dated 14th June, 1864.]

THESE improvements have reference to methods of attaching to ships glass or vitreous-coated plates. In lieu of employing marine glue to connect the backs of glass or vitreous-coated plates to ships, as has before been proposed, glue is employed in conjunction with a suitable fabric, which is previously coated with the glue on both sides. The fabric so coated may be first attached in pieces of any convenient size to the vessel; this is done either by warming the glue till it becomes adhesive, or, in the case of iron ships, by heating the surface of the ship itself; the vitreous plates are then attached by warming the outer surface of the glue, or by gently heating the plates themselves; or the glue-coated fabric may be cut into pieces of the size of the plates, and made to adhere in the first instance to them. In this latter case, it is preferred to attach the pieces of fabric in such a way that a portion of each piece overlaps one side and end of the plate, which portion corresponds to an uncoated portion of the succeeding plate; by this means the lines of junction of the plates are dissimilar to those of the fabric, and less risk is incurred of water getting access to the sides of the ship. Up to this time these vitreous-coated plates have been generally stamped from the back part so as to cause a projection in the centre; this has been principally with the view of preventing them from buckling, when heated, in fixing them to the ship's side; but this form is objectionable, as tending to interfere with the ship's way in the water, and to render the plates liable to injury or to be torn off. One part of the invention consists in employing strips of glass-coated iron to fill up the spaces between these projections, after the plates are attached to the ship's side. For this purpose, the plates are stamped in such a way that the projection occupies all but about a narrow margin at the outer edges of the plates, the unraised part being by preference of the same breadth around every edge of a plate. The plate is stamped to such a depth as will allow for the thickness of the glass or vitreous-coated metal strip, with the coating of glue or glue-covered fabric by which it is attached, so that when complete the surface of the projections of the plates and that of the strips of vitreous-coated metal shall coincide. The projections are also made with their edges as-

square as possible, so that the spaces may be perfectly filled in by the strips. The glass or vitreous-coated strips may be of any convenient length, and in fixing them they are so arranged that one strip rests partly on one plate and partly on another or others, by which means the coated plates are tied together, and are less likely to be removed by any violence. Some of the coated strips are placed at angles to the others, so that the ends of the plates are covered as well as the lengths. The strips of coated metal thus used to cover the edges of the plates may be flat on their under surfaces, so as, together with the cement or cemented fabrics, to fill the hollow spaces between the contiguous plates; or thinner metal, corresponding with that of which the plates are formed, may be used, and their edges turned inwards, by which the edges will be protected. Whatever be the form or thickness of the metal used in making these strips, where it is desired they should overlap or pass across each other; they may with advantage be made thin to admit of two thicknesses of the strips to be placed in the hollow, between two plates, and yet only be flush with the raised parts of the plates. In some cases, also, the strips may be formed with parts at right angles to each other, in the form of the letter T or +, so that the parts intersecting may come in the recesses at the angles, where two, four, or more plates come together.

To PETER SPENCE, *of Smedley New Hall, and* HENRY DAVIS POCHIN, *of Broughton Old Hall, both near Manchester, for an improvement in smelting copper ore.*—[Dated 17th June, 1864.]

THIS invention consists in using, as a flux, the spent shale of the alum manufacture, being the residuum of the shale of the coal measures after it has been acted upon by sulphuric acid for the production of alum.

The quantity of such spent shale necessary for each charge of ore will vary with the character of the ore, and, in practice, is easily ascertained by the workman, who will discover that, when a sufficient quantity has been added, the flux or slag will part easily from the regulus or metal, and enable him to skim off and draw out the slag, without the regulus or metal clinging to it.

In practice, it is found that, by using spent shale for a flux, a slag more than ordinarily free from copper, or, as it is termed, a clean slag, is obtained, which is a matter of great importance in copper smelting, as, when the slag is not clean, there is a great loss of copper in consequence. The patentees claim, "the use of spent shale as a flux in copper smelting."

To RICHARD JONES, *of Botolph-lane, Eastcheap, for an improved method of preserving animal and vegetable substances.*—[Dated 20th June, 1864.]

THE object of this invention is to displace air from the vessel containing the animal or vegetable substance to be preserved, by the introduction into such vessel of an inert fluid, such as water or oil, and then to dis-

place such fluid by the introduction of nitrogen gas, or gases having an affinity for oxygen. For this purpose, the vessels containing the animal or vegetable substance to be preserved, are provided with two necks, sufficiently large to admit of the flow of the inert fluid into and from the vessel, and for the flow therein of the nitrogen gas, or gases having an affinity for oxygen. These vessels, excepting their necks or passages, may be formed of tin plate, the necks or passages being of soft metal. When the cover of these vessels has been made secure, by soldering, to retain the substances to be preserved, the patentee applies over each of these necks, and so as to fit tightly on to them, the ends of an india-rubber pipe, provided with stop-cocks or valves. One of these pipes is in communication with a reservoir of the inert fluid, which is allowed to flow into the vessel under pressure, so as to fully drive out the air contained in the vessel. The other tube is in communication with the reservoir of the nitrogen gas. When all the air has been driven off, and only the inert fluid passes out from the vessel containing the substances to be preserved, the ingress of liquid is stopped, and the nitrogen or other gas having an affinity for oxygen, such as carbonic acid gas, or nitrogen gas with binoxide of nitrogen, is allowed to flow therein, under pressure from the reservoir, until the whole of the inert fluid has been displaced. The patentee then introduces a given quantity of sulphurous acid gas, or binoxide of nitrogen—say of from five to thirty-five cubic inches to the lb. of substance to be preserved, and, by means of pincers, closes up the necks or passages of the vessels, and makes them secure by soldering.

The patentee claims, "displacing air from the vessel containing the substance to be preserved, by the introduction therein of an inert fluid, such as water or oil, and then the displacement of such fluid by the introduction of nitrogen gas, or gases having an affinity for oxygen, substantially as explained."

To JAMES WILSON, *of Exeter, for improvements in tanning, and in the machinery or apparatus employed therein.*—[Dated 7th July, 1864.]

ACCORDING to this invention, the steeping tanks are constructed in a series of four or other convenient number, each containing a circular rotating drum, set with axles in bearings at the sides of the tanks. These drums are formed of two discs, braced together by a series of wooden bars fixed to their periphery, the number of which may vary according to the circumference of the drum; and between each there are arranged and placed two or more moveable sticks or bars to receive the hides or butts. The tanks being filled with liquor, and the drums charged with butts, a reciprocating rotary motion is given to the drums by means of gearing.

In Plate I., fig. 1 represents a plan view, and fig. 2 a sectional elevation of the improved apparatus for tanning: A, A, are the tanks, eight in number; B, B, are moveable troughs, placed at the bottom of the tank, with holes pierced at the side only to disperse the liquor and steam laterally; C, C, are zinc pipes, to convey the liquor from the top of one tank to the bottom of the next, from right to left, the whole of the way round; D, D, boxes into which the liquor flows by means of

valves E, placed in each corner of the tanks when they are required to be emptied; G, the manhole to get to the boxes and pipes therefrom; H, junction for the pipes leading from the valves, and thence to any part of the tan yard. The bars or sticks upon which the hides or butts are placed are kept separate, and yet allowed some "play" by means of wooden pegs, and above these bars, as the hides or butts are placed in the drum, bands of zinc, abont three inches wide, are placed, to take off when necessary to charge the drums; these bands are fixed by screws to keep the sticks or bars in their places.

The patentee claims, "the improvements in tanning, and the machinery or apparatus employed therein, substantially as described."

To THOMAS SHARP, *of Nashville, Tennessee, U.S.A., for certain improvements in tanning hides, and in the apparatus employed therein.*—[Dated 9th July, 1864.]

THIS invention consists, first, in a novel and peculiar arrangement of apparatus, whereby a superior solution for tanning is produced than has hitherto been obtained. The bark is placed in a cylindrical vessel, enclosed in another one of larger dimensions, and a current of steam is admitted into the annular space between the inner and outer vessel. Within the inner vessel is a revolving hollow shaft supplied with arms, terminating in shovels or ploughs; and immediately behind these shovels are small steam pipes (in connection with the arms of a hollow shaft), which discharge steam into the vacuum or space formed in the liquor immediately in rear of the shovels, by which means the tanning matter from the bark is extracted and liquified. In the bottom of the afore-mentioned steaming apparatus is a small door, through which, on being opened, the bark is discharged, after having all the tanning matter extracted by the steaming arrangement. The tannic acid thus extracted from the bark is drawn off from the vessel through a pipe at the bottom on the side of the vessel. The liquid passes first through a sieve to separate the particles that may be floating in it, then through a vessel containing charcoal, then through another pipe and another charcoal vessel, after which, being drawn through a pipe again, and vessel containing coarse sand, it is discharged in a reservoir, and is thus ready for use.

The second part of the invention relates to the treatment of the hides or skins when in the tanning solution. Within a large reservoir containing the tanning solution are a number of false vats or chambers made of plank, and impervious to the liquor. Each vat is supported upon a pivot under its centre, and caused to oscillate by having one end attached to a crank or other mechanical equivalent. Each of these vats are supplied with four valves—two in the top and the others in the bottom—so that, with every oscillation of the vats, these valves open and close alternately, and the hides, which are suspended from copper wires underneath the lid of each vat, are kept constantly swinging to and fro, their surfaces being constantly brought into contact with fresh liquor, from the continual flow of such liquor from the bottom to the top of the vats through the operation of the valves. The temperature of the liquor in the large reservoir is regulated by a pump,

the suction pipe of which passes through a pipe or receptacle containing water, heated to a certain temperature. The suction pipe of the pump is attached to the bottom of the reservoir, the discharge outlet being at the top, thereby causing a continual circulation of the liquor, which is kept in agitation, and also at an even temperature. Attached to the large reservoir is an index, marked with degrees, for indicating the strength of the tanning liquids.

Lastly, the improvements relate to scouring the leather. The shaft of the ordinary drum employed for scouring is perforated at both ends, one end furnishing a supply of water to the leather under operation, and the other end carrying off the water as fast as it is necessary to discharge it.

In Plate I., fig. 1 represents a vertical sectional view of the apparatus for extracting the tannin from the bark, and filtering the liquid before use; fig. 2 is a plan view of the same; and fig. 3 represents a vertical section of the apparatus in which the hides are placed to undergo the process of tanning.

In fig. 1, *a*, *a*, is the steam chamber or "jacket," forming a cylindrical receptacle for the bark and liquor. In the centre of the chamber a hollow vertical shaft *b*, is caused to rotate by means of gearing *c*, from which shaft the arms *d*, *d*, *d*, project, being furnished with shovels or ploughs. The steam pipes *e*, *e*, *e*, pass from the steam shaft down the sides of the arms, and terminate behind the shovels; so that, as the whole rotates to stir the bark, the steam is ejected from the pipes amongst the liquor, and assists in the extraction of the tannin from the bark. When the liquor has been sufficiently saturated with tannin, it is drawn off by the tap *f*, into the first sieve or filter *g*, which separates the floating matters; thence it is conveyed by the pipe *h*, to the next vessel *i*, containing charcoal, and thence through the pipe *h*, to the vessel *k*, which contains coarse sand, after passing through which it may either pass direct to the tanning vessel or to a reservoir. When the bark is spent it may be removed by the door *l*, seen in the plan.

In fig. 3, *m*, *m*, is an outer vessel or chamber, in which a number of false vats *n*, *n*, oscillate on their centres or pivots *o*, *o*. These vats are furnished with an inlet valve *p*, and outlet valve *q*, at each end, and contain rods *r*, *r*, *r*, from which the hides are suspended. The oscillation of the vats is effected by means of a crank *s*, and connecting rod *t*, driven by any motive power, or by hand, and the tanning liquid is pumped from the bottom of the outer chamber *m*, by means of a pump *u*, the pipes of which pass through a steam or hot water cylinder *v*, by which means the liquid is kept heated. The circulation of the liquid amongst the hides is maintained by the motion of the vat and the action of the valves. As one end of the vat sinks, the bottom valve opens with the pressure, and admits tanning liquid, which passes in and forces the liquid above it out at the upper valve. When this end rises again, both valves close, and the opposite ones open, and thus a constantly-changing tanning solution is brought into contact with the hides. The necessary strength of the solution required is regulated and determined daily, as the hides become more or less impregnated, the varying strength of the solution being ascertained by the index *w*.

The patentee claims, "First,—the improved method of extracting the tanning matter from the bark by the combined use of steam

"jackets" and jets, and rotating shovels and ploughs. Secondly,—submitting the hides to a constantly-changing solution of tanning matters, which may be effected by the self-acting mechanism shown, or by other mechanical equivalent. And lastly,—the use of water or liquid passing through the cylinder used in scouring hides, for the purpose of washing away the matters, examples of which have been hereinbefore described, set forth, and fully illustrated."

To RICHARD ARCHIBALD BROOMAN, *of Fleet-street, for improvements in the manufacture of fluoride of silicium,—a communication.*—[Dated 14th July, 1864.]

WHEN fluoride of calcium is added to silicious copper ores, a certain quantity of fluoride of silicium is disengaged. Gay Lussac has also shown that by dissolving, at a high temperature, silicic acid with fluoride of calcium, fluoride of silicium is obtained, but the quantity of fluorine gained from the fluoride of calcium, to produce the fluoride of silicium, is not more than thirty per cent. of the total weight of the fluorine contained in the said fluoride of calcium. The reaction hereafter described, and which is the base of the present discovery, gives, according to the proportions of the added matters, 66 to 88 per cent. of the total weight of the fluorine contained in the fluoride of calcium employed in the docimastic production of fluoride of silicium. By dissolving in a closed crucible, furnished with tubes, in presence of carbon, an intimate mixture of eleven equivalents of silica and eighteen equivalents of fluoride of calcium, there is recovered, first, four equivalents of fluoride of silicium, 66 per cent. of the fluoride contained in the fluoride of calcium; second, six equivalents of oxide of carbon, due to the reaction of the carbon on the oxygen of silica, in presence of the fluorine in the fluoride of calcium. In this reaction, heretofore unknown, the carbon acts as a reducing element of part of the oxygen contained in the silica, and aids the direct union of the fluorine and the silicium, to produce fluoride of silicium. By proportionately increasing the quantity of silica and of carbon without increasing the fluoride of calcium, and by adding to the mixture, to render it fusible, a corresponding proportion of aluminous earth, 88 per cent. of the fluorine in the fluoride of calcium employed is obtained. The inventor obtains commercially, on a large scale, with similar products to those obtained in the closed crucibles, the reaction above described by one of the two following methods:—First method—Dry blocks are provided, containing eleven equivalents of silica, eighteen of fluoride of calcium, thirty of carbon, and four or five parts of aluminous earth. These are dissolved in a retort, or in a cupola, fitted at its mouth with a condensing apparatus, for transforming the fluoride of silicium produced into hydro-fluo-silicic acid. In this method the carbon employed for the reduction of the oxygen of the silica, being contained in the blocks, the coke or other fuel used to obtain the fusion of the gangue does not exceed the quantity necessary to fuse the said gangue. Second method—In a blast furnace, similar to those employed for the reduction of iron ores, blocks containing eleven equivalents of silica, eighteen of fluoride of calcium, and four to five parts

of aluminous earth, are reduced by adding to each charge of blocks a sufficient quantity of coke or other fuel to produce at the same time the reduction of the oxygen of the silica and the fusion of the fluoric gaugue. It is thought that in this method the oxide of carbon generated at the tuyere, by the combustion of the fuel, exercises as much as the carbon a reducing action on the oxygen of the silica contained in the fluoric gangue. From the foregoing facts, it will be seen that carbon employed as an agent for reducing the oxygen contained in silica, dissolved and combined with fluoride of calcium, is an indispensable agent for docimastically producing fluoride of silicium on a commercial scale.

The patentee claims the manufacture of fluoride of silicium, by reducing the oxygen of silica by means of carbon, or of carbonated compounds, in presence of fluoride of calcium, in the manner described.

To ISRAEL SWINDELLS, *of Wigan, Lancashire, for improvements in obtaining hydraulic and other cements from residuums or wastes.*—[Dated 15th July, 1864.]

THIS invention relates, first, to the treatment of alkali wastes, residuum, or what is commonly called blue waste, after the manufacture of soda ash or soda, for the production of cements. Secondly, to the treatment of chrome residuum or waste, for the production of cements. Thirdly, to the treatment of chrome residuum or waste, and alkali waste, by mixing them together, for the production of cements. Fourthly, to the treatment of slag produced by the manufacture of pig or cast iron, for the production of cements.

In treating alkali waste, the patentee takes the waste, after the rough soda ash liquor has been washed out, and passes it through a sieve having about four wires to the square inch, the sieve having been previously placed in a vessel containing hot water: the waste is passed over this sieve, which may be agitated either by hand or steam power, so that all the fine particles of the waste may pass through. The rough cinders and other matters pass over the wire, and fall outside the sieve, and the resulting solution, which is sulphide of lime, is to be withdrawn from time to time, when both sulphur and sulphurous acid may be obtained by any of the well-known methods. When the finer particles of the waste have subsided in the vessel, it may be removed for the further process. The sediment must then be tested for lime, which is generally found to be deficient. This waste usually requires not less than twenty per cent. of hydrate of lime, the waste generally containing from thirty to forty per cent. of lime in various conditions. The sediment is ground under edge stones, or the common mortar mill stones may be used. The weight of sediment to be operated upon is ascertained before adding the lime, and after adding it, twenty per cent. of good clay, containing not less than ten per cent. of alumina, is added. These substances are ground together under the edge stones for not less than fifteen minutes for each charge. After grinding, the mass is removed to be dried, and the mixture is then calcined in any conve-

nient furnace, preferring a reverberatory furnace for this purpose. Four hours is about the time required for the proper calcination of the mixture at a bright red heat, but it is not at any time to be brought up to a white heat, because it is liable to flux if heated too much A portion should be withdrawn, from time to time, and tested by reducing it to powder, and mixing it with water to ascertain its setting qualities; and should the above directions be attended to, the cement will generally set in about ten minutes. After the mixture is sufficiently calcined, it is withdrawn from the furnace, and, when cooled, ground under edge stones, and passed through a sieve of not less than twenty-four-wires to the square inch; after which it is to be packed in suitable casks. When undergoing calcination in the furnace, the mixture is stirred once or twice in each hour.

The invention relates, secondly, to the manufacture of cement from chrome waste or residuum, after the manufacture of bi-chromate of potash, or of any of the chrome salts. This chrome waste generally contains the proper amount of lime, silica, alumina, and peroxide of iron, all suitable for making good cement. The patentee takes, say, four measures of chrome waste, and one measure and a half of coals, slack, cinders, or other carbonaceous matter containing carbon, and then grinds these substances under edge stones, as before mentioned in the manufacture of cements from alkali waste, until the mixture is properly incorporated together into a pasty mass. Some chrome residuums contain chromates; and when these abound to any considerable extent, one per cent. of sulphur, more or less, is added, but carbon is all that is generally requisite to decompose and unite the various matters when undergoing calcination in the furnace. When the waste and carbonaceous matters have been ground together under the aforesaid edge stones, the mass may be dried and calcined, as described in the making of cement from alkali waste. When the cement is withdrawn from the furnace, it is to be ground and sifted, as described in the making of cement from alkali waste. Some of the chrome wastes, which have been made from rich ores, are deficient in alumina, and the waste and it may be also in lime, because all the chrome manufacturers do not use one uniform quantity; when this is the case, more lime and aluminous clays are to be added, when ground together in the wet state. Should the chrome waste be deficient in alumina or clay, the cement will not be hydraulic, that is, not setting in or under water. The aforesaid chrome waste generally contains from ten to fifteen per cent. of aluminous clays, or the alumina is in combination with silica, forming silicate of alumina and silicate of lime. In the manufacture of these cements, there should always be present not less than fifteen per cent. of aluminous clays, and about forty-five to fifty per cent. of hydrate of lime.

The invention relates, thirdly, to the manufacture of cement according to the following method:—Take equal measures, or equal weights, of chrome waste and alkali waste, namely, after the lime and clay have been added to them, and grind these two compounds together under edge stones, adding the proper proportion of coals, slack, or any other carbonaceous matter, according to the number of measures or weight of chrome waste used, as before described in the making of cement from chrome waste, grinding into a pasty state. Afterwards dry and

calcine as aforesaid, and then grind under edge stones and sift in the usual manner.

The invention relates, fourthly, to the manufacture of cement from dross or slag, after the manufacture of pig or cast iron. This slag consists of silica, alumina, and compounds of lime. The patentee takes the slag, and grinds it by any convenient process to fine powder, and then mixes and grinds together, under edge stones, about sixty per cent. of slag powder, thirty per cent. of hydrate of lime, and ten per cent. of coals or slack, or any other carbonaceous matter; after which he dries and calcines the compound, as before described; or he takes four measures of fine ground slag, three measures of slaked lime, and one measure of coals or slack, or any other carbonaceous matter, and grinds them together under edge stones, taking care that the lime is used immediately it has fallen into soft powder. To make the slag cement hydraulic, twenty per cent. of good clay is added. When clay is used, about twenty per cent. more lime must be used. The patentee takes four measures of ground slag, four measures of lime just fallen into powder, one measure of coals, slack, or any other carbonaceous matter, and one measure of good ordinary fire-clay, and grinds them together, and proceeds, as before described, regarding calcination and grinding under edge stones, and sifting as directed in the making of cements from alkali waste.

He claims, "First,—the manufacture of cement from alkali wastes by the use of clays and lime, or chalk. Secondly,—the manufacture of cement from residuum or wastes, from the making of bi-chrome or the chromates, by the use of coals, slack, or any other carbonaceous matter and sulphur. Thirdly,—the manufacture of cements, by mixing together the chrome waste and alkali waste, by the use of lime or chalk, clay, and coals, or slack, or any other carbonaceous matter. And, Fourthly,—the manufacture of cement from slag or dross from the manufacture of iron, by the use of lime or chalk, clay, and coals, or any other carbonaceous matter, as such improvements are described."

To ANDREW BARCLAY, *of Kilmarnock, N.B., for improvements in the manufacture of pig iron, and in the machinery or apparatus employed therein.*—[Dated 16th July, 1864.]

THIS invention relates, in the first place, to the manufacture of "pig iron," by mixing in the "pig bed," together with the sand or other material usually employed, a quantity of engine or furnace ashes, coke, charcoal, or other carbonaceous or refuse matters, for the purpose of the better carbonizing or softening of the iron; second—in casting the pigs, or bars of iron, with small indentations or recesses at each side of the bar, and opposite to each other, for the purpose of rendering the pigs or bars more easily broken by the hammer or otherwise. The apparatus employed for forming these indentations in the pigs consists essentially of a pattern, made of metal or wood, in the sides or outer surface of which indentations or notches are formed similar to those to be produced in the pigs themselves. This pattern is moulded in sand in the ordinary manner by workmen, and thus the pig bed is produced; or it may be attached to a crane, and

impressed in the sand by means of a lever actuating the pattern suspended from the crane chain.

The patentee claims, "First,—the using of the refuse carbonaceous matter from furnaces about works, and employing it in the pig bed, as described. Second,—the use of carbonaceous matter generally, wheresoever obtained, as described. And, Third,—the mode of forming, and the forming itself, of the pigs of metal, with notches or indentations, for the purpose of facilitating fracture, as described.",

---

To GUSTAVUS PALMER HARDING, *of Cornhill, for improvements in the manufacture of guns and ordnance.*—[Dated 19th July, 1864.]

THIS invention consists in manufacturing guns or pieces of ordnance of two, three, or more thicknesses of metal, which thicknesses may be of like or of different descriptions of metal. It is preferred, however, that in all cases the interior thickness should be of comparatively hard metal, whilst the outer ones are of relatively soft metal.

In Plate I., fig. 1 is a sectional view of a gun constructed according to this invention. It is composed of a breech piece *a*, trunnion ring *b*, and tubes or inner linings c, c^1, c^2, c^3, c^4, the breech end being closed by a conical plug *d*, and a screw d^1. The mode of constructing the improved gun is as follows:—A breech piece *a*, is welded into form, and the interior thereof is bored in such manner as to obtain a truly cylindrical surface, the rear end thereof being formed, as shown in fig. 2, which represents the mode of putting the breech piece on to the first inner lining *c*. This lining is placed over a mandril e^1, fixed to the end of a ram *e*, the breech piece *a*, being forced thereon by the rising of the ram *e*, forcing the inner lining upwards towards the head of the press, which is formed as a die or mould to receive the rear end of the breech piece. By these means close contact is obtained between the interior of the breech piece *a*, towards the end thereof and the exterior of the firsti nner lining *c*; and in order to complete the union of the two surfaces around the opening, through the rear end, a mandril is drawn through such part, the bulb on which is somewhat larger than the opening through the inner lining *c*; and when drawn therethrough it expands that part of the inner lining *c*, into close contact with the breech piece *a*,—a similar mandril being drawn through the length of the first inner lining *c*, to effect close union between it and the breech piece *a*. The inner lining c^1, after being drawn to a size to fit the interior of the lining *c*, is placed therein, and by means of a mandril *f*, being drawn therethrough, as shown at fig. 3, expanded into the lining *c*, in such manner as to effect a close union of the adjacent surfaces; the other inner linings being expanded therein in a similar manner. Motion is given to the mandril by hydraulic power. When the gun has been thus built up to the desired internal diameter, the opening in the rear end has formed therein a screw thread, as shown in fig. 1, to receive a screw plug d^1; there is also formed therein a short conical hole to receive a conical plug *d*, placed therein from the muzzle end of the gun,—a trunnion ring *b*, being forced on to the gun by a hydraulic press, or fixed thereto by other suitable means. It is preferred that the interior thickness should be of compa-

ratively hard steel, whilst the outer ones are of relatively softer and softer metal. If desired, the gun may be rifled in the ordinary manner, or by means of projections formed on the bulb of the mandril.

The patentee claims, "the combined arrangement employed in the manufacture of guns and ordnance, substantially as shown and described."

To JOSEPH LAUBEREAU, *of Paris, for improvements in producing motive power by the expansion and contraction of air,—available also for elevating water and other liquids.*—[Dated 20th July, 1864.]

IN Plate II., fig. 1 is a section of the improved air engine, and fig. 2 a sectional elevation of the pump employed either for refrigerating purposes connected with the motor, or for raising or projecting water or other liquids for different industrial purposes. *a, a*, is the base plate or stand of the engine, which is cast with an entry *b*, for charging the fuel, an outlet *c*, for smoke and gases, and with a ridge below to receive the grate *d*. On the centre of the stand is placed a cover *e*, provided with a lateral opening e^1, for the passage of the flame, and on its outer flange a cap *f*, which forms the lower part of the heated chamber as it receives, on its lower surface, the action of the fire, and transmits the heat thus imparted to the air in the chamber. On the flange of this cap *f*, is adapted the cylindrical double case *g*, charged with water, and which constitutes the sides of the air chamber. This cylinder is closed on its upper face with the inner and outer covers *h*, and h^1, the space between which is equally charged with water; and in this vertical chamber is suspended a vertical travelling partition *i*, by means of a rod i^1, passing through a stuffing box i^2, charged with washers of cork laid one on the other, and steeped in grease. This travelling partition is fixed to the rod i^1, by a wrought-iron cross head, and filled in to the extent indicated with plaster of Paris, or other light non-conducting substance, and the surface is covered with an elastic cushion formed of woven or textile materials. The space within the chamber not filled in by the partition constitutes the working air chamber, which is either hot or cold, according to the position occupied by the partition. Thus, when the partition is raised, all the air in the chamber is driven to the bottom, where the caloric imparted through the cap *f*, causes the air to expand; whereas, when the partition is lowered to the bottom, the air is driven into the space above, which, being surrounded by water, causes the same to contract; and in order to effect this change of temperature as rapidly as possible, a peculiar shape is given to the parts with which it comes in contact on its passage from one chamber to the other, so as to cause the air to be laminated or divided into thin strata. This alternate expansion and contraction of the same volume of air produces motive power by means of a piston *j*, working in a cylinder *k*, provided with a rod j^1, working in a guide j^2, and a connecting rod *l*, a crank *m*, and a driving shaft *n*, carrying a second crank *o*, for working the partition by means of the connecting rod *p*, and a fly wheel not shown. This second crank is set about one-third of a revolution in advance of the cylinder crank; thus, when the piston is at its bottom stroke, the partition should be at about its top stroke, and the hot,

and, consequently, compressed air, from the chamber below passing immediately under the piston through the passage k^1, raises the piston. The partition then descends, forming a cold chamber, above which, by the condensation, a partial vacuum is formed, causing the descent of the piston. In order to prevent the formation of vapour from the oils which may be used for lubricating the piston, the cylinder bottom is inclined towards a cup k^2, for the reception of such oils, which are drawn off by means of the cock q; and to prevent the passage of air behind the piston ring or rings, an elastic tube or roller j^3, stretched on the piston, is employed, which is compressed to a sufficient extent by the ring or rings themselves.

In order to prevent the water contained in the cylindrical double case g, from overheating, which would have the effect of impairing the vacuum formed in the cold chamber, the water is drawn off as fast as it becomes heated, and its place is supplied with fresh cold water by means of the small diaphragm pump, fig. 2, worked by the air in the chamber; for this purpose the pump is connected by its nozzle r, to the branch s^1, of the pipe s, by a tube, the alternate contraction and expansion of the air causing the diaphragm t, to move backwards and forwards. On its backward stroke a supply of water is drawn into the pump through the elastic valve u^1, attached to the nozzle u, and on its forward stroke the same amount is expelled through the valve v^1, and the nozzle v, which is connected by a pipe to the inlet pipe v^2, of the engine, and forced into the water envelope, from which a similar amount of heated water is expelled through the pipe v^3. To compensate for leakage or loss of air during the working of the machine, an atmospheric valve w, is used, composed of a small band of elastic material strained under a washer pierced with a central hole. As this valve is in constant communication with the cold chamber, whenever the vacuum therein descends beyond the requisite amount, the valve is forced open by the atmosphere from without, and the requisite amount of air admitted for the proper working of the engine.

The inventor also shows a small engine working on the same principle as the one above described, but constructed mainly of thin metal. It is heated by a small gas flame, or lamp, instead of solid fuel, by means of which the engine can be started in a few seconds. The whole of the air chamber, with the water as well as the cylinder, can be made of thin plate or drawn tube, the different parts of which, except those in direct contact with the flame, are united by solder. In order to prevent the oil used for lubricating the piston from penetrating into the air chamber, the feed pipe is raised up above the surface of the cylinder bottom, and the oil accumulating in such space is liberated by means of a cock or a simple plug.

The patentee claims, "First,—the general construction and arrangement of the parts described. Secondly,—the mechanical construction of the piston. Thirdly,—the shape and connection of the cylinder bottom with the air chamber. Fourthly,—the self-acting atmospheric valve for compensating leakage. Fifthly,—the combination of the diaphragm pump with the new engine, for the purposes specified. And, Sixthly,—the general construction and arrangement of the small engine."

To ALFRED TOPP and JOHN HOLT, *both of Farnworth, Lancashire, for improvements in machinery or apparatus for twisting and doubling cotton and other fibrous materials, applicable to the manufacture of driving bands and other purposes.*—[Dated 21st July, 1864.]

THIS invention relates to twisting or doubling machinery, in which flyers are employed with two necks or eyes, through which the material passes, and consists in adapting the creel between the said necks or eyes, whereby the flyer is caused to revolve around it. The material passing from the creel is conducted through one of the necks or eyes, and from thence along a leg of the flyer to the other neck or eye. The creel is mounted loosely upon the centre of motion of the flyer.

In Plate I., fig. 1 represents the improved arrangement in plan view, and fig. 2 is an elevation thereof. *a*, is the framework, within which is mounted the flyer *b*. This flyer is rectangular in form, provided with necks *c*, *d*, which run in bearings *e*, carried by the framework *a*; *f*, is a table, provided with brackets *g*, extending upwards, and mounted at their ends loosely upon the necks *c*, *d*, by which necks therefore the table is suspended; *h*, *h*, *h*, are brackets also formed upon the table *f*, and provided with slots, within which are situate the spindles *i*, *i*, *i*, for carrying the bobbins from which the material to be twisted or doubled is drawn,—the said table *f*, and brackets *h*, constituting therefore a creel. Within the slots are also rods k, k^1, k^2, capable of moving upward and downward therein. In the figures, one bobbin *l*, only is shown, it being supposed that the operation of twisting several ends is to be performed preparatory to that of doubling for the manufacture of driving bands, as is well understood. The ends to be twisted are conducted from the bobbin *l*, over and under the guide rods k, k^1, k^2, as shown by the dotted line, and from thence through a hole formed in a guide piece *m*, affixed to the table *f*; after this they pass through the neck *c*, along one side of the flyer *b*, and then through the neck *d*, to a bobbin or other usual apparatus on which they are to be wound; such bobbin being driven by a surface drum, or by any other usual arrangement. Motion is communicated to the flyer *b*, by means of a pulley *n*; and the flyer being thus caused to revolve, will twist the material which is taken up, as before mentioned. It has been observed, that the operation is supposed to be that for preparing the material for the after process of twisting in the manufacture of driving bands, but the twisting thus effected may be for any other desired purpose. It will be perceived, that as the creel is mounted loosely upon the centre of motion of the flyer, the flyer will be at liberty to revolve around it,—the bobbins remaining stationary, or nearly so. To effect a doubling operation, a bobbin is placed upon each of the spindles *i*, and the ends are conducted under and over the guide rods *k*, as may be found desirable, and from thence to the guide plate *m*, in which there are as many apertures as there are creel bobbins, each strand passing through a separate hole; after which the combined threads enter the neck *c*, and flyer leg *b*, as before mentioned.

The patentees claim, "placing the material to be twisted or doubled between the necks of the flyers, and mounting the creel which carries such material loosely upon the centre of motion of the flyer."

To James Higgins, *of Salford, for improvements in machinery or apparatus for cleaning cotton from seeds.*—[Dated 21st July, 1864.]

This invention relates to an improvement on the MacCarthay gin, and consists, first, in allowing the roller to move from the blade, for which purpose the roller is to be pressed towards the blade by means of a spring or weight, and a stop is applied to prevent it from being pressed forward beyond a certain distance; secondly, a revolving excentric, or similar mechanism, is applied to the said roller, whereby it is caused to move to and fro longitudinally during the working of the machine.

In Plate I., fig. 1 represents a portion of a MacCarthay gin constructed according to these improvements in sectional elevation, and fig. 2 is a partial front view thereof. The general outline of the machine is that for which letters patent were granted to Henry Higgins, bearing date 14th April, 1864 (see Vol. XXI., page 214). *a*, is the fixed blade, and *b*, the vibrating blade. The usual roller acting in conjunction with the blades is shown at *c*, but in this instance it is mounted at each end in bell-crank levers *d*, capable of turning freely upon the driving shaft *e*. The ends *d**, of the above-mentioned levers are drawn downwards by springs *f*; so that the roller *c*, is carried by their tension towards the blades *a*, *b*, but its extent of motion in that direction is determined by adjustable stops *g*. Should any obstruction occur to the passage of the cotton between the roller and the blades, then the pressure upon the former will overcome the tension of the springs *f*, and it will turn backward to allow the cotton to pass. The stops *g*, being adjustable, admit of any desired position of the roller in reference to the blades. The next part of the improvements is also shown in the figs. above referred to. Upon the lever *d*, is mounted a fixed pin *h*, which projects into a grooved cam *i*, mounted fast upon the axis of the roller *c*; as, therefore, the roller revolves, it is caused to move to and fro in a longitudinal direction.

The patentee claims, "Firstly,—mounting the roller *c*, so as to render it capable of moving from the blades by undue pressure, and also rendering it adjustable in reference to the said blades. Secondly,—imparting motion to the said roller in the direction of its axis."

To Theodore Bourne, *of New York, U.S.A., for improvements in rollers for cotton gins and other machines,—being a communication.*—[Dated 30th July, 1864.]

The improved roller forming the subject of the present invention is made of wood or of any suitable material, turned off in the usual manner. Grooves or intersections are then formed upon the surface of the roller in any desired width or direction, to serve as receptacles for rings. Pieces or strips of india-rubber or other elastic substance, or alternate strips or rings of india-rubber or other elastic substance, and leather or other suitable material, may be placed upon the roller. The roller thus prepared is covered with leather or any suitable covering, and is grooved and prepared for use in the customary manner.

The figure in Plate I. is a transverse section of one of the improved rollers suitable for a cotton gin. *a*, is the axle of the roller, and *b*, the

roller itself; *c*, *c*, are annular grooves, filled up by rings *d*, of india-rubber, or of any other suitable elastic or yielding substance. When the rings *d*, are made of india-rubber, they may be easily expanded and slipped over the ends of the roller into their respective grooves. When the rings are all in their places, and the circumference of the roller is true, it is covered with leather, which is grooved in the ordinary manner. By this means a roller is produced, the surface of which is sufficiently inflexible, yet elastic, and easily yielding to the pressure of fibrous materials, such rollers being peculiarly adapted for separating the fibres of cotton from the seeds when applied to cotton gins, but they may also be applied to other machines in which a partially yielding surface is desirable.

The patentee claims, "The mode of constructing rollers for cotton gins and other machines, and the use thereof, the surfaces of which rollers are alternately elastic and inflexible, in the manner and for the purposes described."

To GRAHAM STEVENSON, *of Airdrie, Lanarkshire, for improvements in valves for apparatus worked by steam or other fluid.*—[Dated 23rd July, 1864.]

IN Plate II., fig. 1 shows in vertical section the upper part of a steam hammer with a moving cylinder and a tubular piston rod, fitted according to this invention. The steam enters and leaves the cylinder by the tubular rod 1; the top of the rod 1, is connected to the entablature 2, with the usual annual bearing surfaces, forming a universal joint, which is easy for any slight vibration or jarring of the rod. The lower annular bearing surface is in the bottom of the steam case 3, formed in the entablature 2, and the upper bearing surface is in the cover 4, which cover is formed with a short branch 5, for the attachment of the exhaust pipe 6. An opening 7, is formed in the top of the rod 1, and communicates with the exhaust 6, through the centre of the upper annular bearing surface. A diaphragm 8, is formed across the inside of the tubular rod 1, near the top, and two sets of ports are formed through the sides, one set below, and the other set above, the diaphragm 8. In the example represented a rod 9, which serves to carry the piston more firmly, is held in the diaphragm 8, by its tapered end. The improved valve 10, is cylindrical, and is shown in cross section in fig. 2; it encircles the rod 1, at the part within the steam case 3, and between the spherical bearing surfaces, where the ports are formed through the sides of the rod. The valve fits closely at its top and bottom, but its middle part is hollowed internally, so that a longitudinal or radial section resembles the longitudinal section of a common slide valve. When the valve 10 is lifted so as to uncover the lower ports into the tubular rod, it covers the upper ports, and the steam enters by the lower ports into the rod, and thence into the cylinder; but when the valve 10, is lowered into the position in which it is represented in fig. 1, its hollow part puts the two sets of ports in communication, and the steam passes from the cylinder up the rod through the ports to the space above the diaphragm 8, and thence away by the exhaust pipe 6; the steam pressure being on

all sides of the valve, it is always in equilibrio, and it works with the least friction. The valve is by preference cut through at one side, as best seen in fig. 2, and at that part it is formed with flanges 11, which are united by screw bolts, so that by drawing the flanges together, more or less, its fit on the rod may be adjusted with the greatest nicety. To prevent the passage of steam at the joint, the valve is there made to fit the pipe from top to bottom without the middle hollow, which extends round the rest of the valve, whilst at the corresponding part of the rod no ports are formed. The cylindrical valve may be worked in various ways. In the simple arrangement shown in fig, 1, a pair of rods 12 are attached, one to each side of the valve 10, and pass out through stuffing boxes in the cover to levers 13, on a rocking shaft 14, actuated in the usual way. If the hammer is double-acting, the same valve will answer, with a suitable disposition of the ports or openings in the rod 1; such, for example, as is shown in vertical section in fig. 3, and in cross section in fig. 4. The rod 1 is formed with two passages, leading, one, 15, to the top of the piston, and the other, 16, to the bottom of it. When the valve is worked by hand, it can be made to give steam below the piston or not at pleasure, by moving it more or less down. The valve is shown in the position for the steam to escape from the upper side of the piston, without entering to the other side. To make the hammer work automatically with either single or double action, the pulley on the reversing bar, acted on by the "race" on the moving cylinder, is mounted in excentric bushes, which can be adjusted by a handle or lever, so that the valve may be shifted, more or less, accordingly as the hammer is worked with single or double action. An arrangement for a steam-engine cylinder is represented in figs. 5, 6, and 7; fig. 5 being a longitudinal section; fig. 6, a plan, with valve chest cover removed; and fig. 7, a cross section. In this arrangement, two of the cylindrical valves 10, are used, and they work on two pipes 18, which are fitted in the same line at each end of a central exhaust chamber 19, their outer and opposite ends communicating with the ends of the cylinder 20. The pipes 18 are made separately, and are entered into their places, and through the valves, through openings in the end of the casing afterwards closed by covers. They are formed (like the tubular hammer rod 1) with diaphragms 8, having ports on each side, and the two valves are worked by the same pair of rods 12. The improved valve may be in two pieces, instead of being open at one side only, and instead of being cylindrical, or of a circular section, it may be elliptical, oval, polygonal, rectangular, or of other convenient form in section, but the cylindrical form is obviously preferable. The valve may be made to act by being turned, instead of moving longitudinally, in which case it is made with indentations or openings, which uncover the inlet ports to the steam when the valve is turned into the proper position. This arrangement will be understood from fig. 8, which shows in transverse section a valve, shifted by a rocking shaft 21, a lever on that shaft being connected to it by a link 22, whilst the shaft enters the steam case by a stuffing box.

The patentee claims, "First,—the constructing of valves for apparatus worked by steam or other fluid, substantially in the improved mode described. Secondly,—the applying of a valve directly to the

tubular piston rod of a moving cylinder steam hammer, substantially as described."

To JOHN HENRY JOHNSON, *of Lincoln's-inn-fields, for improvements in safety valves,—being a communication.*—[Dated 25th July, 1864.]

THIS invention consists in the employment of a small supplementary valve operating as hereinafter described in combination with a safety valve.

The figure in Plate II. represents a vertical sectional elevation of the improved safety apparatus. The steam from the boiler enters at *a*, through channels in the stem of the small valve *c*, and fills the chamber *b*, thereby exerting its pressure upon the upper surface of the main safety valve *d*, which rests upon two annular concentric valve seats or faces e, e^1, between which are situate the escape apertures *o*. This main valve, which is also guided by a cruciform stem *f*, receives on its under face the direct pressure of the steam from the boiler, and, consequently, it is balanced upon its seat by the upper and under pressure exerted thereon. Should the steam pressure become unduly elevated, the small valve *c*, will be raised, and the solid part or plug *g*, on the bottom of the valve spindle will close the communication between the boiler and the chamber *b*, and the steam which previously pressed down upon the valve *d*, will escape through the orifice at *i*, *i*, which is opened by the lifting of the small valve or plug *c*. The pressure on the main valve being no longer balanced, it will be opened, and will allow the steam to escape direct from the boiler through the escape apertures *o*, *o*. The small valve is represented as being fitted inside a separate tube or seating f^2, which is tapped into the main casting of the chamber *b*, and may therefore be easily removed when required for cleaning or repairs. The weight g^1, of the small valve may be applied as shown directly to the valve itself without the intervention of a lever, and, for convenience, it may he made hollow, so as to contain mercury or other substance for weighting the same, or it may be otherwise constructed.

The patentee claims, "First,—the general construction and arrangement of safety apparatus for steam generators, and for compressed air or gas reservoirs, substantially as described. Second,—the combination of a small weighted valve with a larger unweighted valve, upon which larger valve the steam, air, or gas pressure is balanced, substantially in the manner and for the purpose described."

To THOMAS DIXON, *of Birmingham, for improvements in sugar funnels or sugar moulds,—being a communication.*—[Dated 26th July, 1864.]

THE object of this invention is to strengthen the wide open end of sugar moulds.

The figure in Plate I. represents partly in elevation a sugar funnel or sugar mould, the wide open end of which is strengthened according to this invention. *a*, is the hollow cone of sheet iron forming the body

of the mould, which is bent from sheet iron, and rivetted in the usual way; *b*, is the metallic hoop rivetted to the wide end of the hollow cone *a*. The metal at the wide end of the mould *a*, is doubled at *c*, so as to give two thicknesses of metal at that part. The metallic hoop *b*, by which the doubled end *c*, of the mould is further strengthened, is conical both within and without, excepting at the extremity of its widest part, at which part is a strong beading *d*, of a nearly cylindrical figure in cross section. The beading *d*, has on its inner side a shoulder *e*, upon which the doubled edge *c*, of the mould *a*, rests, and by which it is protected from injury. The metallic hoop *b*, is sprung on to the part *c*, and secured by rivets. The narrow end or top of the mould *a*, may be protected and strengthened where great strength is required, in the manner described with respect to the wide end.

The patentee claims, "strengthening the wide open end of sugar funnels or sugar moulds by first folding or doubling the metal at the said end, and afterwards rivetting thereto a metallic hoop or ring of the kind described."

To JOSEPH HAMILTON BEATTIE, *of Dowgate-hill, for improvements in the arrangement and construction of pumps,—being a communication.*—[Dated 26th July, 1864.]

THIS invention consists in so constructing pumps that they can be used as force or lift pumps, and, at the same time, the common suction pipe and discharge pipe can be dispensed with.

The figure in Plate II. is a section of the improved pump; *c*, *c*, *c*, is the barrel placed at the bottom of the cistern *l*, *l*, or at some little distance below the water line *d*, *d*, and fitted at the top with a bush *f*, *f*, the same fitting close to the tubular rod *a*, *a*, which works vertically up and down in the barrel *c*, *c*. This tubular rod is fitted at the bottom with a valve *b*, which opens to allow the water to enter it when depressed, and closes to prevent the escape of water when the tubular rod is raised. The barrel *c*, *c*, is also fitted at the bottom with a valve *e*, similar to the valve *b*, but acting in an inverse manner. *m*, and m^1, are stops to regulate the height to which the valves are lifted; *g*, is the discharge pipe of the tubular rod *a*, *a*; *h*, *h*, is a lever attached to the tubular rod by the link *k*, and having the moveable weight *i*, *i*, which counterbalances the tubular rod *a*, *a*.

The action is as follows:—When the tubular rod is raised by the lever *h*, the valve *e*, in the barrel *c*, *c*, admits the water into the space between the valves *b*, and *e*; and when the rod is depressed the valve *b*, opens and admits the water into the rod, and the alternate raising and depressing continues until the water is discharged by the discharge pipe *g*. The weight *i*, on the lever *h*, is placed so as to counterbalance the rod *a*, with the water contained in it. Where the rod is of very great length, valves similar to the valves *b*, and *e*, can be placed inside, at different distances, if requisite or desired; also, if the tubular rod is of very small diameter, clacks can be used instead of the valves *b*, and *e*. The pump can be made to force water by moving the weight *i*, on the lever *h*, nearer the rod *a*, so that the counterpoise shall be disturbed, and, by means of a pipe or hose attached to the discharge pipe *g*,

the water may be forced the required height. Instead of a lever, a driving wheel may be used.

To Henry Attwood, *of Wapping-wall, Shadwell, for improvements in packing and lubricating parts of steam engines and other machinery.*—[Dated 1st August, 1864.]

This invention consists, first, in making stuffing boxes steam-tight, by introducing rings made of soft metal, hollow or tubular, and circular or elliptical in section, into the stuffing box, one over the other, until the box is full. The rings are made of such a size that they just fit easily around the piston rod and into the box; then, when the gland is screwed down upon them, they become slightly compressed, and, by expanding laterally, a tight joint is made. It is obvious that a continuous spiral may be used in place of separate rings.

In Plate II, fig. 1 shows a transverse section of a packing, composed as above described. The rings are composed of a metal such as is now commonly used for forming soft metal bearings, and the internal and external diameters of the rings, before they are compressed by the gland being screwed down upon them, are such that the rings may fit loosely around the rod to be packed, and also within the box. These rings are formed from a straight length of tube of the diameter required for this purpose. The tube is first filled with wax, and then bent into a ring, and the ends soldered together. In some cases solid rings of soft metal are employed, which fit the piston rod and the box, as before, and each ring has a V-form groove in its upper surface, and about the centre thereof, and another corresponding groove in its under surface. In putting the rings into the box there is interposed between each soft metal ring and the next a hard metal ring of diamond-formed section, so that when the gland is screwed down, the top and bottom angles of such section squeeze the soft metal rings both outwards and inwards, and so make tight joints. A section of a portion of a packing constructed of a series of rings, as above described, is shown at fig. 2; the soft metal rings, which have the V grooves in their upper and under surfaces, are by preference of soft metal, such as is now commonly used for soft metal bearings; the rings which are interposed between them are by preference of steel or iron, though other metal may be employed. The soft metal rings are by preference cast of the form desired, and, after casting, the internal diameter of the rings may be bored out to fit loosely the rod which it is desired to pack.

For the purpose of lubricating parts of machinery, which forms the second part of the invention, a small reservoir is employed, surrounded with a steam jacket, to contain tallow and keep it in a melted state. In the reservoir is a cylinder, open at the top, and containing a piston, the rod of which is connected with a lever, pivotting conveniently on a fulcrum on the cover of the reservoir. At the bottom of the cylinder there is a passage into it from the reservoir, and this passage is furnished with an inlet valve; from the cylinder there is another passage, furnished with an outlet valve, and communicating by a pipe to the part of the engine or machine to which it is desired that the lubricating matter should be supplied. The lever which actuates the piston

is connected with any moving part of the apparatus, and at each stroke a portion of lubricating material is forced into the part of the machine or engine in which it is required. By altering the distance from the fulcrum of the connection for working the lever, the stroke of the piston, and the quantity of lubricating matter supplied, may be regulated as desired.

Fig. 3 shows a vertical section of this lubricating apparatus. *a*, is the reservoir for containing the tallow, which is closed at the top by a cover a^1, and is surrounded by a jacket *b*. Steam is admitted into the space between the jacket and reservoir by the pipe *c*, and is allowed to pass away together with any condensed water by the pipe *d*; the tallow in the reservoir is thus kept melted. In place of the tallow in the reservoir being kept melted by the reservoir being surrounded by a steam jacket, the tallow in the reservoir may be kept heated by a steam pipe passing into or through it. Within the reservoir is a force pump, composed of a cylinder *e*, open at the top, and having fitted within it a plunger *f*; a rod f^1, from this plunger rises up through a hole bored for it in the cover a^1, of the reservoir, and at its upper end is connected to the lever *g*, which is supported, as is shown, from the cover a^1, of the cylinder; *h*, is a passage from the bottom of the reservoir to the bottom of the cylinder; and in this passage is an inlet valve *i*. From the bottom of the cylinder is also an outlet passage *k*, fitted with a valve k^1. This passage leads from the bottom of the cylinder through the centre of the screw stem *l*, by which the apparatus is screwed on to the steam supply pipe of a steam engine, in order to lubricate the face of the slide, or on to the top of a bearing, or other part of a machine requiring to be lubricated. The lever *g*, is connected by the rod *m*, with any moving part of the apparatus, so as to give to the lever a reciprocating motion, and at each stroke of the lever a portion of lubricating material is forced into the part of the machine or engine in which it is required. The lever *g*, has several holes formed in it at distances apart from each other, as is shown, so that the rod *m*, can be connected to the lever at any desired distance from its fulcrum, and by this means the quantity of lubricating matter supplied may be regulated as desired.

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

May 16th, 1865.

J. R. McCLEAN, Esq., President, in the Chair.

The paper read was, "*On the maintenance of railway rolling stock,*" by Mr. Edward Fletcher.

This communication related to the rolling stock belonging to the North-Eastern Railway Company, the statistics of which was comprised in twenty-nine tables, made up at annual periods extending over thirteen years, from 1852 to 1864 inclusive, showing the total number of the

different descriptions of stock, and the average age of every class, at the end of each year.

The rolling stock was embraced under four distinct heads—locomotive engines, carriages, merchandise waggons, and chaldron coal waggons; the carriages and merchandise waggons being again subdivided into separate classes, of all of which a summary was given. The tables had been arranged with the view of showing, in a comprehensive form, the age of the different classes of stock, and the average of the whole. And it was submitted, that if the average age of all the stock did not exceed one-half the number of years which might be found by experience to be a fair average of the existence or life of the stock, then that in justice was done to the stock in maintenance. Another object of these tables had been to show what percentage the annual expenditure in maintenance bore to the first cost of the stock. It was believed that if these, or similar, tables were kept up with care, they would in a few years be the means of affording to the directors of any railway company good data for checking the annual expenditure, and for forming a correct opinion as to the sufficiency or insufficiency of the maintenance. The tables likewise showed the cost of maintenance of each vehicle per annum; and, in the case of locomotive engines, the cost per mile run.

With regard to the ultimate age, or life, of rolling stock, the author was of opinion that the improved rolling stock of the present day, built of carefully-selected and well-seasoned timber, and materials of the best quality—superior as it was in all respects to that built twenty years ago—might be fully calculated to have a life of from twenty-five to thirty years; assuming always that the stock was of such a character that it would not be necessary to break it up on any other ground than that of decay. It was also to be remarked that, on all large railways, the quantity of rolling stock was always increasing, the result of which was to keep down the average age of the stock; and having a large amount of new stock, on which there was little expenditure for some years, the percentage of outlay was proportionately diminished. Making allowances on these points, the conclusion was arrived at, that carriage stock might be fully maintained by an outlay of about 12 per cent. on its cost, waggon stock by an outlay of 6½ per cent., and locomotive stock by an outlay of 12¼ per cent. The chaldron waggon stock, which was peculiar to the north of England, generally had cast-iron wheels, was without springs, and was subject to great breakage by inclined planes and other hard usage; so that, whereas the general waggon stock only cost 6½ per cent. on its first cost for maintenance, the chaldron waggon stock cost 17½ per cent. This stock was by degrees being replaced by 8-ton waggons of superior construction. An 8-ton coal waggon would cost £90, and three chaldron waggons, to carry the same quantity of coals, £75; but the cost of maintenance in the first case would be only £5. 10*s*., whilst in the second it would amount to £13, showing that the superior waggon was the cheaper one of the two.

The number of locomotive engines belonging to the company at the end of 1864 was 504, and their average age was 12·48 years. Assuming that the duration, or life, of an engine was twenty-five years, then the company should have been rebuilding at the rate of twenty engines annually, to be paid for out of revenue, in order to keep the stock up

to its original value; but the table showed that, for the last five years, an average of only eleven engines had been rebuilt, including under this head only those which were entirely new, and of a different class when rebuilt. But taking into account the engines of the same class which had been so treated, the total number reconstructed had been twenty per annum. The principal part of the engines so altered during the thirteen years, from 1852 to 1864, were those which were old when they came into the possession of the company.

The following statement showed the total number of the different descriptions of stock, and the average age at the end of the year 1864; also the average cost of repairing per vehicle per annum, and the percentage of repairs, and of rebuilding on the first cost, for the thirteen years:—

Description.	Total Number.	Average Age.	Cost of Repairing and Rebuilding per Vehicle per Annum.	Percentage of Repairs and Rebuilding on Total Cost.	Percentage of Rebuilding on Total Cost.	Cost per Mile for Repairing and Upholding.	Cost per Mile for Extraordinary Repairs, included under "Repairs and Upholding."
		Years.	£. s. d.			d.	d.
Locomotive Engines ...	504	12·48	...	12·55	...	2·95	1·95
Carriages	1,370	9·75	22 0 9	19·26	4·46	...	...
Waggons	17,429	10·31	4 8 4	6·39	2·89	...	...
Chaldron Coal Waggons	11,872	...	2 15 0	17·42	...	...	.

The communication was accompanied by a very elaborate series of tables.

MECHANICAL ENGINEERS' SOCIETY.

(*Continued from page* 370, *Vol. XXI.*)

The next paper read was "*On the construction and results of working of the large steam dredgers on the Clyde,*" by Mr. Andrew Duncan, of Glasgow.

The improvements in the channel of the river Clyde were commenced in 1770, under the direction of Mr. Goulbourne, of Chester. At that time the navigable depth to Glasgow was only 3 feet at high water spring tides, with 1¼ foot at low water; while the high water of neap tides did not reach Glasgow at all. The river was crossed by seven fords, one being as far down the river as Dumbuck, about twelve miles below Glasgow, which had only 2 feet depth over it at low water. The first operation seems to have been the removal of the Dumbuck ford; and numerous cross jetties were afterwards shot out from either bank

as far up as Glasgow, for the purpose of narrowing the channel, their outer ends being subsequently connected by parallel dykes. Soon after 1798 a few ploughs and a dredging machine, worked by manual labour, were employed in deepening the shallowest places; and the result of these operations was to enable vessels drawing 6 feet of water to come up to Glasgow at high water spring tides.

By the introduction of steam dredgers upon the Clyde, very important improvements have been effected in enlarging the channel of the river. In 1824 the first steam dredging machine was obtained, which now belongs to the town of Dumbarton, and is at work on the river Leven, running out from the foot of Loch Lomond into the Clyde. By that time the Liverpool traders were coming up to Glasgow at high water spring tides, drawing 11 feet of water. In 1831, there were two vessels drawing 13 feet; in 1836, six vessels drawing 15 feet; in 1839, one drawing 17 feet; in 1853, two drawing 19 feet; in 1860, eight drawing 19 feet; and in 1863, two vessels drawing 21 feet arrived at Glasgow. The register tonnage of the vessels arriving and departing from Glasgow now exceeds three millions annually; and the minimum depth of the river is now not less than 12 feet at low water, with a rise of 9 feet at average spring tides, and 7 feet at neap tides. The deepening and widening of the channel is still in progress, and more powerful machinery is in course of construction, in order to hasten on the work. The depth which is now contemplated throughout the whole length of the river up to Glasgow is 15 feet at low water, giving 24 feet depth of high water at spring tides, and 22 feet at neap tides.

As regards the deposit to be removed from the river bed, the greater portion of it comes from the drainage of the city, all the sewers of which discharge into the harbour, where the deposit lodges; also, a considerable quantity of sand is brought down from the upper reaches of the river by the land floods, and lodges chiefly above Glasgow bridge. One of the two large double dredging machines is kept constantly at work in the harbour, the maintenance of which costs about £11,000 annually, and three-fourths of this amount may be said to be due to city sewage.

The entire dredging plant of the river consists of two large double dredgers and three single dredgers, making five in all: connected with which there are 350 punts, each capable of carrying 8 cubic yards, or 10 tons of material; one tug steamer of 80-horse power; and four screw hopper barges, each capable of carrying 300 tons. During the last twenty years, 8,114,872 cubic yards, or 10,143,590 tons of material, have been removed by dredging; last year's work, ending June, 1864, being 632,272 cubic yards, or 790,340 tons.

The first double dredger, No. 1, was constructed in 1851 by Messrs. Murdoch Aitken and Co., of Glasgow. The hull is of iron, 98½ feet long, 31 feet broad, and 10 feet deep, drawing 5 feet of water. The engine is a direct-acting marine engine, with cylinder 37 inches diameter and 3 feet stroke, and makes about 33 revolutions per minute. The boiler is a flue boiler with four furnaces, worked at a pressure of 4lbs. above the atmosphere, and burning about 44 cwts. of coal per day of 10 hours. The bucket frames are of timber, trussed with iron rods, and the buckets can dredge in 22½ feet depth of water.

The buckets are 38 in number in each well, and each contains, when quite full, 3½ cubic feet. The motion is communicated from the engine to the upper tumbler by cast-iron shafting. The tumbler makes about 6½ turns per minute, or 13 buckets per minute; but as the buckets are never quite full, the quantity lifted, when working in good material, is about 10 tons in four minutes, or about 2 cubic feet per bucket. Taking the year ending June, 1864, the total quantity of material lifted by this dredger was 143,360 cubic yards, or 179,200 tons; and as the total number of engine hours was 2483, the average quantity lifted per day of 10 hours was about 720 tons.

The material is discharged over the stern of this dredger, which arrangement was preferred to discharging at the sides, inasmuch as less room is occupied in filling the punts by discharging over the stern; but this plan has the disadvantage of causing a loss of time while the punts are being shifted after each has been filled. Another disadvantage is, that when working during flood tide in the lower reaches of the river, where the current is much stronger than in the harbour, the punts become nearly unmanageable, the current forcing them so hard against the stern of the dredger, which is always moored with its bow up-stream, as to render the shifting of the punts when filled a work of considerable labour; so much so, in fact, that working on the flood tide in the lower reaches of the river was avoided as much as possible.

The cost of this dredger was £8500. The crew required to work the dredger and punts consists of eighteen in all, namely:—Captain, mate, engineer, fireman, bow craneman, sternman, wellman, two deck-hands, cook, watchman, and seven men connected with the punts. The expenses of working during the year ending 30th June, 1863, were:—Wages, £916. 19*s*. 2*d*.; coals, £204. 10*s*. 7*d*.; stores, £73. 11*s*. 5*d*.; making the total working expenses, £1195. 1*s*. 2*d*.; and the average annual cost of repairs is about £580.

The other large double dredger was constructed in 1855 by Messrs. Thomas Wingate and Co., of Glasgow; and is arranged so as to discharge over the sides, in order to obviate the complaints brought against the previous dredger when working in the lower reaches of the river, for which this one was principally intended and is generally used. The crew required to work this dredger, exclusive of the crews on board the screw hopper barges, is twelve in all, namely:—Captain, engineer, fireman, mate, cook, watchman, and six deckhands. The expenses of working during the year ending June, 1863, amounted to—Wages, £562. 1*s*. 4*d*.; coals, £171. 1*s*. 6*d*.; stores, £95. 4*s*. 6*d*.; total working expenses, £828. 7*s*. 4*d*. The annual average cost of repairs is about £980, being considerably more than in the case of No. 1 dredger, which works in soft soapy sludge, whereas this works in sand.

The dredger is built entirely of iron, and is 120 feet long and 33 feet broad, with a flat bottom and 5 feet draft of water; the plates are 7-16ths inch thick at the bottom, and 5-16ths inch at the sides. Two low-pressure cylindrical flue boilers are fixed in the centre of the vessel, measuring 6 feet in diameter and 15 feet long, and working at 3lbs. pressure above the atmosphere. The coal consumed is about 2½ tons per day of 10 hours. The engine is a single side-lever condensing engine, with 37 inch cylinder and 3-feet stroke, running at an average

speed of about 32 revolutions per minute, and driving the tumbler shafts of the two bucket frames at the reduced speed of 6 revolutions per minute, by spur gearing. Either set of buckets can be stopped and started independently of the other by means of clutch boxes worked by levers upon deck.

The power is communicated to the tumbler shafts through friction wheels. By this means any risk of damage to the machinery is prevented.

The bucket frames or dredging ladders consist each of a pair of wrought-iron plate girders, 77 feet long and 3 feet 9 inches deep in the centre, fixed parallel to each other with 2 feet 3 inches space between them, and stayed together by transverse plate stays. These frames carry a series of cast-iron rollers, upon which the bucket links travel; and a cast-iron tumbler at the top and bottom ends, over which the links work. Each ladder is suspended at the upper end by cast-iron dead-eyes, firmly bolted to the main framing of the dredger. Through these dead-eyes the upper tumbler shaft passes freely, and round them the ladder turns in being lifted or lowered: thus the upper tumbler shaft does not bear any part of the weight of the ladder. Each ladder works in a vertical well passing through the bottom of the vessel. There are 41 buckets to each ladder.

The depth of excavation of the buckets is regulated by a lifting chain attached to the lower end of the bucket frame, and hoisted at the rate of about 26 feet per minute by the windlass or hoisting barrel, which is driven by a small shaft from the engine through a clutch box and friction wheel, similar to those giving motion to the buckets, and also worked by a lever upon deck. The depth of dredging is continually gauged during work by a man stationed at the bucket well holding a gauging rod resting on the river bottom, and having the lifting lever at hand, and also a break handle for lowering the bucket frame, so as to keep the buckets constantly adjusted to a uniform depth of cut, according to the surface of the ground. A self-indicating gauge has also been fitted up on deck, so that the captain, by glancing at the position of the bucket frame, may in an instant tell at what depth below the surface of the water the points of the buckets are working. The greatest depth the dredger can work at is about 28 feet.

The forward motion for the cutting of the buckets is given by a bow chain 1 inch diameter, attached to a single-fluked anchor, weighing 12 cwts., placed about 600 feet ahead of the dredger when at the commencement of a cut. The chain is hauled in with a slow motion by a windlass, driven by a second small shaft from the engine through a clutch box and friction wheel, and having a set of change wheels for the purpose of regulating the rate of advance according to the nature of the material that is being excavated. This rate of advance varies from about 4½ feet per minute in soft sand to 1½ feet per minute in hard material. The dredging is done in parallel cuts of about 120 feet length. A corresponding windlass, with two mooring chains at the stern of the vessel, gives the means of drawing back the dredger to commence a second line of excavation parallel to the former one. This windlass is driven by a small high-pressure donkey engine, with a pair of 12 inch cylinders; the dredging engine and machinery standing still during the time occupied in going astern, which is about 15 minutes,

the speed being about 8 feet per minute. Two side warp lines extend from each side of the dredger, to steady it constantly during the progress of each cut, and to shift its position into the new line of excavation; they are worked by surging heads, driven by the engine, or by hand power when required. The kedge anchors for these side warps are placed forwards of the dredger; the warps are also passed round leading blocks when required, since it is desirable they should be as nearly at right angles to the dredger as possible. The two warps on the side next the sailing channel of the river are lowered or slacked out when any vessel is passing, but are immediately tightened up again when the vessel has passed.

This dredger has now been at work for nine years, and has not required any repairs, excepting for the wear and tear of the buckets, links, and rollers, and the usual repairs on the hull, &c. The upper tumbler, however, having been found too low to allow of the shoot being placed at a sufficient height and slope for loading the large screw hopper barges, was raised 2½ feet higher. The steeled mouths of the buckets last for the year's work of about nine months, when the buckets require to be thoroughly overhauled and put in repair. The pins and links of the bucket chains last generally about four months, and are replaced from time to time as required, a supply of duplicates being kept ready on board for the purpose. The rollers over which the buckets travel in ascending the dredging ladder are of cast iron, 1 inch thick in the barrel, with wrought-iron spindles, having 1¾ inch journals laid with steel, which lasts about three months before being worn out. These run in small cast-iron steps, with hard wood caps, fixed on the top flange of the ladder, which are readily renewed when worn out,—the cast-iron bush lasting about two months, and the wood cap about nine months. Each bucket weighs 5½ cwts., and the total weight of each set of buckets and links is about 7½ cwts. The cubic content of each bucket is 3¾ cubic feet, and the average quantity of material brought up by each when working in sand is about 2 cubic feet. The number of buckets discharged per minute is 13 to 14 at the regular speed of about 6½ revolutions per minute of the tumbler shaft.

The total quantity of material raised per day of 10 working hours varies very much according to the nature of the material dredged. Taking the entire work performed by this machine during last year, namely, 303,957 tons in 2680 engine hours, the average work for a day of 10 engine hours is 1134 tons, or 113½ tons per hour. The total quantity of material lifted by the two large dredging machines during the year ending 30th June, 1864, amounts to 386,752 cubic yards, of which about 250,000 cubic yards may be considered as due to maintenance, and the remainder to the permanent widening and deepening of the channel.

The cost of dredging per cubic yard, taking the year ending 30th June, 1863, as performed by the dredger first described, was as follows, the dredged material being conveyed away by the punts:—Wages, coals, stores, repairs, and 5 per cent. interest, 3·02 pence; repairs of punts, 1·59 pence; towing punts to and from place of deposit, 2·28 pence; discharging punts by waggons, 12·29 pence; total cost of dredging per cubic yard, 19·18 pence.

The cost of dredging as performed by the last described dredger

during the same period, with the screw hopper barges for carrying away the material, was as follows:—Wages, coals, stores, repairs, and 5 per cent. interest, 4·06 pence; discharging by hopper barges—wages, coals, stores, repairs, and interest, 2·30 pence; total cost of dredging per cubic yard, 6·36 pence.

The dredged material is disposed of according to two different modes. That filled into the 10 ton punts is towed down to some convenient part of the river, and discharged by barrows or waggons on to the fields adjoining. That put into the screw hopper barges is carried down to Loch Long, beyond the mouth of the Clyde, and deposited by opening the hopper doors at the bottom of the carrying space. At the place where the deposit is made, the water is upwards of 200 feet deep, and the mouth of the loch is about 27 miles below Glasgow; the hopper barges at present at work contain each 300 tons of dredgings, and steam from 8 to 9 miles per hour. This latter mode is by far the most economical way of disposing of the dredged material, as seen by the above statement of the cost by the two methods; and the result has been so satisfactory that two additional barges are now being constructed, each to be capable of carrying 400 tons, making six barges in all.

In conclusion, it may be mentioned that a larger and more powerful single dredger is now being constructed for the Clyde Trust by Messrs. A. and J. Inglis, of Glasgow. The dimensions of this dredger will be: extreme length, 157 feet; extreme breadth, 29 feet; depth, 10 feet 9 inches; and bucket frame capable of working in upwards of 30 feet depth of water. The engine will be horizontal, with cylinder 44 inches diameter, and adapted for a 3-feet stroke; the boiler will be tubular, and capable of working to 25lbs. pressure per square inch above the atmosphere. The buckets will be 39 in number, discharging over the side; the pitch of the bucket chain will be 30 inches, and each bucket, when quite full, will contain 13½ cubic feet. The flat bucket back, with the double links, will be made of malleable cast iron, with the links cast solid upon it: this construction has been found to last, without requiring repair, for more than double the time of the ordinary backs with rivetted links. The bucket rollers will not require spindles, as they will have necks cast on the ends of the rollers, which will answer for the spindles. The lower tumbler shaft will be of wrought iron, having strong rings or hoops at the journals, so that when worn the hoops can be easily removed and replaced. The only other difference of any consequence from the present dredgers will be in using grooved frictional gearing for driving the hoisting barrel that lifts the dredging ladder, instead of spur gearing with a friction wheel, as previously described. The total cost of the dredger will be about £17,000.

The next paper read was "*On the working and capacity of blast furnaces*," by CHARLES COCHRANE, of Dudley.

AT a former meeting of this Institution, in 1860, the writer read a paper on a method of taking off the gas from a close-topped blast furnace at the Ormesby Iron Works, Middlesbrough. In the original

construction of closed-top furnace, a lifting valve was used for charging. The material for the charges was filled into the space surrounding the charging valve, which, when drawn up, allowed the materials to fall into the furnace; while the gas was taken off from the furnace top by a side passage.

The usual plan of closed top adopted in blast furnaces is that of a cone placed in the throat of the furnace, which cone, on being lowered into the position shown, permits the fall of the charge into the furnace. The tendency of the material in this case is to roll outwards from the charging cone to the side of the furnace, and thence back again to the centre.

It was thought at the time of adopting the first plan that the height of the materials carried by the same furnace would be increased, and that a corresponding economy in consumption of fuel would result, owing to the circumstance that, where the lowering cone is adopted, the level of the materials must always be maintained at a certain distance below the top, to ensure the fall of the cone at charging time. The first plan was devised with due regard, as it was thought, to the arrangement of the materials in the furnace; and it was intended that they should arrange themselves as a hollow cone; part of the larger material rolling to the outside of the furnace and part to the centre.

As long as the furnace could be kept pretty full, this arrangement of materials was insured; but the practical result was, that it was found impossible to keep the furnace sufficiently full to secure the distribution of the materials in the manner intended. The level of the surface of the materials being generally below that intended, the consequence was, that the material on falling into the furnace, was shot into the centre, from whence the largest pieces rolled outwards. The result of this was, irregular working of the furnace over a period of many months, during which an explanation of the irregularity was in vain sought for. At one time it was thought the back pressure of the escaping gas had something to do with the irregularity; at another, the cause was sought for in the difficulty of keeping the hopper valve of the furnace tight, and the necessity for using small material around the valve as a kind of lute between every charge, to prevent the escape of the gas; until it occurred to the writer that the arrangement of the materials in the furnace was the sole explanation of the difficulty, and that as all the material was shot into the centre of the furnace, the small pieces would remain there, whilst the large would roll to the outside. Believing that it was of great importance, in order to secure uniform results, that there should be a uniform distribution of the heated gas from the hearth over the entire horizontal area of the furnace at each stage of its height, he considered that the effect of any small material being collected in any portion of the area would be to obstruct the passage of the gas at that part, and so prevent that portion of the material from being heated to its proper degree of temperature.

Deeming this to be the explanation of the irregularities experienced in the working of the furnace, the writer devised a method of distributing the material so as to prevent such a result, by the introduction of a frustrum of a cone, suspended inside the throat of the furnace, which was found to be all that was necessary. The materials then

arranged themselves in the desired manner; and the result has since been a perfect uniformity in the working of the furnace. Where previously a yield of foundry iron from the same furnace could not be relied upon for more than about twenty-four hours at a time, and the annoyance was incurred of the furnace suddenly changing to white iron, the production of white iron, except when desired, is now unknown. A consideration of these facts will lead to a fair estimate of the importance of the arrangement of the materials in a blast furnace. Anything that opposes the free passage of the ascending heated gas at any part of the furnace must direct the gas into another channel, and the material thus left insufficiently acted upon finds its way into the hearth at a low temperature, and white iron is the result.

The effect produced on the distribution of material by this internal frustrum of a cone is obviously similar to that of the ordinary lowering cone when lowered; and the latter has now consequently been finally adopted at the Ormesby Iron Works as the permanent form of the arrangement, and is now being carried out there.

The most perfect action of a blast furnace the writer conceives to consist in the development of the highest temperature needed for the production of the required quality of iron, in a layer or stratum as little removed from the tuyeres as possible; and the gradual absorption of the heat from the ascending gas by the materials through which it passes, until it leaves the throat of the furnace at the lowest possible temperature. Anything which tends to cause a more perfect absorption of the heat developed in the hearth, or to lower the level of the region of highest temperature in the furnace, will thus be beneficial.

With regard to the absorption of the heat from the gas, it is obvious that the hotter the temperature at which the gas escapes, the more wasteful must be the effect; and, theoretically, the height of a furnace should be increased until the temperature of the escaping gas is reduced to that of the materials on their introduction into the furnace top. This is the theoretical limit to the height of a blast furnace; but it must not be forgotten that the less the difference in temperature between two bodies, the less rapid is the communication of heat from the hotter to the cooler; hence, for the absorption of the last few degrees of temperature from the ascending gas a much greater height of material is necessary than where the gas and the material differ more widely in temperature. Already, with 50 to 60 feet height of blast furnace in the Middlesbrough district, the temperature of the escaping gas does not exceed 500° to 600° Fahr.; and it is a question to be answered only by experiment how far the gain from the heights of 70 to 75 feet already accomplished at Middlesbrough, and further heights of 10 or 20 feet additional that are contemplated, will compensate for the extra work in raising the materials to the additional height and for the more substantial plant required. In the direction of height there is unquestionably on this account a limit which will speedily be attained; supposing the limit be not previously determined by the necessity for increased pressure of blast and by the increased difficulty in working the furnaces.

As regards the benefit produced in the working of a furnace by lowering the level of the region of highest temperature, it is evident

that this benefit is of the same nature as in the previous case, since the lowering of that level is equivalent to an increase in the height of the furnace. The level of the region of highest temperature is dependent upon the heat of the blast, and is brought down nearer to the tuyeres only by using a hotter blast; and, in the writer's opinion, the chief source of economy yet to be attained in the working of blast furnaces, independent of the more extended application of the waste gas, lies in the use of blast heated to a still higher temperature than that hitherto known. The yield of iron from any ironstone is governed by the percentage of iron it contains, and the consumption of limestone by the nature of the ironstone; and both these are, therefore, fixed quantities for the special materials employed. But that is not the case with the coke, which offers a fruitful source of saving; and in what way, therefore, this saving is effected by increased temperature of the blast becomes a most important question, involving as it does the general theory of hot blast.

It appears to the writer that, in order to explain the effect of the hot blast, it is necessary to regard the nitrogen of the atmosphere and the generated carbonic oxide as the great heat "carriers" in the operations of the blast furnace. This consideration involves two others, namely, the time required for heating the nitrogen from its initial temperature at entering the furnace up to that needed for the fusion of the materials in the furnace; and also the method by which the gases are heated. Taking it for granted, that the colder, and consequently the denser, pure oxygen is the more intense is the combustion of any body burning in it, there is evidently no necessity for heating this constituent of the atmosphere. It is further obvious that, supposing 3000° Fahr. be the temperature required for the fusion of the materials on their reaching the hearth, then every pound of the nitrogen introduced by the blast must be raised to that temperature before the fusion can take place.

Now, in a cold-blast furnace, the nitrogen is introduced at the lowest temperature, and requires necessarily the longest time for being raised to the requisite temperature; hence the maximum temperature in the furnace is produced at a higher level, and diffused over a larger portion of the furnace where it is not wanted; and it is consequently impossible in some cases ever to get the temperature sufficiently high at any part of the furnace to produce more than the qualities of iron known as forge iron. In proof of this may be mentioned an attempt made some years ago at the Ormesby Iron Works, Middlesbrough, to produce cold-blast iron of a gray or foundry quality. It was in vain, however, that the burden of ironstone was reduced, that is, the proportion of coke increased: the temperature of the hearth could not be sufficiently raised to produce any other quality than forge iron, the effect of the reduced burden being only to throw an increased temperature into higher regions of the furnace. The attempt was consequently abandoned; not, however, until it became obvious that the burden might have been still further diminished with only the effect of diffusing the hottest temperature into still higher regions of the furnace.

Whatever heat is imparted to the nitrogen of the atmosphere, and also to the carbonic oxide generated in the furnace, is of course deli-

vered up again to the materials in the furnace, excepting only the portion lost by the temperature at which the gas escapes at the throat of the furnace. The effect of heating the nitrogen before its entrance into the furnace now becomes more clear. It has a shorter distance to travel up within the furnace before the maximum temperature is attained, for the simple reason that, having been partly heated already, it requires less time to become further heated to the temperature required in the furnace, having got the start by the amount of its initial temperature. Hence the fusing heat is generated nearer to the tuyeres; and this circumstance, together with the smaller expansion of hot blast compared with cold blast on entering the furnace, seems to furnish a satisfactory explanation of the more immediate effect of heated air in preventing diffusion within the furnace of the region of highest temperature.

As to the method of heating the nitrogen, it must be borne in mind that the heat generated in a blast furnace is obtained wholly or nearly so by the imperfect combustion of the carbon of the coke into carbonic oxide as the final result, a process by which theoretically only about one-fourth of the total quantity of heat is developed that would be obtained by the perfect combustion of the same carbon into carbonic acid, showing a loss in the fuel of about 75 per cent. of heat; since 1 lb. of carbon burnt into carbonic oxide developes only 2880 units of heat, while 1 lb. of carbon burnt into carbonic acid developes about 11,700 units of heat. For although the combustion of the carbon of the coke in the blast furnace is partially or wholly converted into carbonic acid so long as the supply of oxygen is in excess, this condition applies only to the lower portion of the furnace nearest the tuyeres; and this carbonic acid becomes ultimately reduced to carbonic oxide by passing through the excess of carbon in the mass of incandescent coke occupying the upper portion of the furnace. If, therefore, the nitrogen be heated partially or wholly before entering the furnace, by any means involving the perfect combustion of the fuel employed into carbonic acid, it follows that a large saving in fuel must necessarily result; and to give an idea of the real influence of the nitrogen of the atmosphere on the consumption of fuel in the blast furnace, the writer has endeavoured to express numerically the effects produced by taking three different cases of the blast entering the furnace at the various temperatures of 50°, 650°, and 1150° Fahr. respectively. It is assumed that the air has to be heated within the furnace to 3000° Fahr. in each case; that 1 lb. of carbon burnt into carbonic oxide will develope 2880 units of heat, that is, will raise 2880 lbs. of water through 1° Fahr.; and that the specific heat of air is 275, compared with that of water as 1·000. It is further assumed, that 4500 cubic feet of blast enter the furnace per minute; and as 1000 cubic feet weigh 76 lbs., the weight of blast entering the furnace per minute will be 342 lbs., 77 per cent. of which, or 263 lbs. weight, is nitrogen.

In the three cases cited, it will be seen that the work to be done within the furnace is to raise the temperature of the air through

2950° in the first case,
2350° in the second,
1850° in the third.

In the first case, namely, to heat 263 lbs. of nitrogen through 2950°, there will be required

$$\frac{263 \times 2950 \times \cdot 275}{2880} = 74 \text{ lbs. of carbon per minute.}$$

In the second case, namely, to heat 263 lbs. of nitrogen through 2350°, there will be required

$$\frac{263 \times 2350 \times \cdot 275}{2880} = 59 \text{ lbs. of carbon per minute.}$$

In the third case, namely, to heat 263 lbs. of nitrogen through 1850°, there will be required

$$\frac{263 \times 1850 \times \cdot 275}{2880} = 46 \text{ lbs. of carbon per minute.}$$

These results show, that to raise the temperature of the blast from 50° to 650° before it enters the furnace, causes a saving in the blast furnace of 15 lbs. of coke out of 74, or about 20 per cent.; and that a further increase of temperature from 650° to 1150° occasions a saving of 13 lbs. out of 59, or about 22 per cent. To show that these calculations are not so merely theoretical as might at first be supposed, it may be here stated that, in the writer's experience, the raising of the temperature of the blast from 650° to 1150° at the Ormesby Iron Works, has accomplished an actual saving of from 17 to 18 per cent. of coke in the blast furnace; and this was effected at an expense of coal outside the furnace of about one-half the weight of coke saved within the furnace. The writer believes, however, that, were it in his power to compare two exactly similar systems of hot-air stoves, the additional fuel consumed outside the furnace would approximate more nearly to one-third of the weight saved inside the furnace than to one-half. But the difficulty of having to compare the ordinary cast-iron stoves with the regenerative hot-blast stoves, by which the highest named temperature of 1150° is attained, is too great to allow of the comparison being made more precisely.

In the cold-blast furnace, the method of heating the air is simply by its direct contact with the heated material and incandescent coke, and it is heated altogether at the expense of carbon burnt only into carbonic oxide instead of into carbonic acid. In the hot-blast furnace, by the more complete combustion of the heating fuel in the hot-blast stoves, exterior to the furnace, the nitrogen is heated, not only at a cost of fuel represented by a saving of theoretically three-fourths in the actual weight of the coke required within the furnace to raise the nitrogen to the same temperature, but also with the further advantage, that instead of burning coke, it is coal that is used for the purpose. In other words, for every pound of coal economically burnt outside the furnace in raising the temperature of the blast, three pounds of coke will be saved within the furnace, whether the furnace be open or closed at the top.

It may be thought that a comparison made between an open-topped furnace, where the gas burns freely as it escapes, and a close-topped furnace, where no such combustion takes place, is not a fair one, and that the combustion of the gas at the throat of the open-topped fur-

nace, by imparting heat to the materials at the throat of the furnace, would tell in favour of the consumption of fuel in the open-topped furnace. But facts speak otherwise, and it appears that there is practically no difference whatever due to this cause.

It will thus be seen that a definite limit to the height of a furnace is soon reached in practice; and that the advantage derived from increasing the actual height of a furnace may be partly secured by increasing the temperature of the blast, and thereby lowering the region of maximum temperature in the furnace.

The only question that remains is as to the diameter of the furnace. In reference to this dimension, the danger that has been alluded to from the formation of cold masses in the centre of a blast furnace serves as a caution against the more dangerous formation of cold masses attached to the sides of the furnace, technically called scaffoldings. It is obvious that, if the width of the boshes of a furnace be large in proportion to the height and the volume of the ascending gas, there will be a tendency to unequal diffusion of the heat imparted by that gas over the successive horizontal sections of the furnace, and irregularities in its working will consequently set in. There is then a limit to the diameter of the boshes, the largest of which yet in use is believed to be about 21 feet; beyond this size it appears very questionable whether any beneficial result would arise, though a furnace has been stated to be in course of construction at Cwm Celyn, having a diameter of 24 feet at the boshes.

The nature of the materials of the charge in any contemplated increase of the dimensions of a blast furnace must be most scrupulously borne in mind. The density of the coke is the most important consideration; but next to that is the friability of the ironstone itself. In the Staffordshire district it would be useless to build furnaces of the height contemplated and actually employed in the Middlesbrough district, for the simple reason that the Staffordshire coke is friable, and would be crushed most injuriously by the weight of superimposed material.

It is thus evident that the actual dimensions of a blast furnace, in any particular instance, are much dependent upon special local circumstances; but the writer has endeavoured to point out the general principles which guide the determination of the dimensions to be adopted.

ROYAL INSTITUTION OF GREAT BRITAIN.

THE following is the substance of a Lecture, delivered on Friday, May 12, 1865, by MR. FREDERICK FIELD, F.R.S., "*On magenta and its derivative colours.*"

ANILINE was discovered in the year 1826, by Unverdorben, who obtained it from the destructive distillation of indigo. A short time afterwards, Runge and Fritsche observed that by the action of strong hydrate of potash upon the dye, aniline was eliminated in far greater quantity. Indigo, in small fragments, is heated in a retort with a strong

solution of caustic potash, and in the distillate, which consists of many products, there is found a thin and nearly colourless fluid, having a specific gravity of 1028, a peculiar but not disagreeable odour, and a pungent biting taste. When kept for some time, even in the dark and in stoppered bottles, it assumes a darker tint, and becomes ultimately a very dark brown. Unverdorben called it "crystalline," Runge "kyonal," and Fritsche "aniline."

This substance is a nitrogenised base, and is capable, when combined with acids, of forming those beautiful crystallised salts, nearly all of which have been carefully examined by Dr. Hofmann and other chemists.

There are many other sources besides indigo, from which aniline may be obtained. For commercial purposes it is always prepared from nitro-benzol, a substance derived from the action of nitric acid upon benzol.

$$C_6\,H_6 + H\,N\,O_3 = C_6\,H_5\,N\,O_2 + H_2\,O. *$$

Nitro-benzol, when agitated with water, acetic acid, and iron, yields aniline.

$$C_6\,H_5\,N\,O_2 + 6\,H = C_6\,H_7\,N + 2\,H_2\,O.$$

Benzol was originally discovered by Mr. Faraday in 1825, in his investigations upon the gaseous products from oils subsequently obtained by the decomposition of benzoic acid by means of caustic lime. Mr. Mansfield, however, succeeded in producing it in much larger quantities from coal-tar naphtha. When the lighter portions of this compound are distilled fractionally until a constant boiling point of 180° Fahr. is arrived at, the product consists of pure benzol, identical with the carbohydrogen obtained by Mr. Faraday.

From the earliest discovery of aniline, it was noticed that certain oxidising agents, when mixed with a solution of its salts, produced a fine violet tint. Even in minute quantities, a few drops of hypochlorite of lime render it purple. There is another test for aniline, which I will show you, and which, as far as I am aware, has not been observed previously. If the red gases obtained by the decomposition of nitric acid by starch or sugar, be passed into an aqueous solution of aniline, the liquid speedily assumes a yellow colour, owing to the formation of a new base—azophenylamine, which is gradually precipitated as a bright yellow powder. It was not, however, until the year 1856 that aniline was applied to any great practical purpose, although, from the beauty of its compounds, and from its comparative accessibility, it had from the time of its discovery become a great favourite with chemists.

Mr. Perkin was the first who produced colour on an extensive scale from this base. He added a solution of bichromate of potash to a salt of aniline, and from the precipitate thereby produced, he isolated a magnificent purple dye, he termed "mauve," which at once became popular, and indeed at the time almost universal. It may truly be said that this discovery has identified Mr. Perkin with the aniline colours, and that he will be always associated with one of the most striking and brilliant passages in the history of chemistry as applied to the industrial arts.

* $C = 12 — O = 16.$

It cannot be supposed that such a discovery would be allowed to rest. A mine had been opened which chemists began to explore, and in such numbers, and with such avidity and zeal, as almost to lead us to anticipate that its riches will soon be exhausted. The action of numerous bodies upon aniline and its homologues were found to be productive of colour. Nitrate of silver, nitrate of mercury, chloride of mercury, chloride of tin, arsenic acid, iodine, and many others, when heated with the base, gave a rich crimson colour, in more or less abundance; and, although it would be impossible for me to enter into a disquisition on the comparative merits of these various methods for the production of colour, I trust to be able to produce magenta, although in somewhat crude form, at this lecture table, and also to dye this tassel of silk from a solution of its salt. The reagent I will employ is iodine. A few crystals of this element are here placed in a tube with about twice their weight of aniline. Heat is at once evolved, and with the assistance of a higher temperature from the spirit lamp, you will observe that, in a few moments, intense colour is developed. If a few drops are now poured into spirit, and this solution added to water, a fine rose-coloured tint will appear.

It may seem strange to those who have read Dr. Hofmann's beautiful researches upon the aniline substitutive products, his chloraniline, bromaniline, iodaniline, and a multitude of others, that he had not observed this curious reaction; and this leads me to tell you, *en passant* for time will not allow me to dwell upon this interesting topic to-night, that aniline, when perfectly pure, does not yield any amount of colour, with most of the reagents mentioned above—a most important fact discovered by Dr. Hofmann and Mr. Nicholson, and which has given rise to one of the most difficult questions which yet remain to be answered. I will simply say, that it appears that there must be a homologue of aniline present with that base to produce the colour you see before you, although that homologue, *per se*, will give no colour whatever. Thus, for exampel, toluidine, $C_7 H_9 N$, when treated with oxidising agents, does not produce colour; let it be mixed with aniline, and the dye is immediately developed.

The tintorial power of the salts of magenta is something marvellous. No dye that I have examined, whether from the animal, mineral, or vegetable world, can bear comparison for one moment with this crimson colour obtained from aniline. One grain in a million times its weight of water gives a pure red; in ten millions, a rose pink; in twenty millions, a decided blush; and even in fifty millions, with a white screen behind the vessel in which it is dissolved, an evident glow. Magenta has been carefully studied and analysed by Dr. Hofmann, who gives us the following formula:—

$$C_{20} H_{21} N_3 O, H_2 O.$$

Although the salts of magenta are possessed of such wonderful colouring capacity, the base itself is colourless; and it is remarkable that the union of base and acid for the formation of a salt does not appear to take place in dilute solutions in the cold; at any rate, not immediately. In these two vessels, one containing hot and the other cold water, an equal quantity of magenta base is added, and also an

equal amount of dilute sulphuric acid. In the hot liquid colour is instantaneously developed; in the cold solution the liquid remains colourless. If now hot water be introduced to raise the temperature, you will observe at once the characteristic rose tint. It may be imagined, therefore, that having free acid in a solution of base without production of colour, it is possible to have free alkali in a coloured solution of a salt of the base without depriving it of its tint. Such is the case. If to a hot solution of acetate of magenta, for example, caustic soda is added, the colour is immediately discharged, but in a cold solution the colour remains for a long time unchanged.

Dr. Hofmann discovered, about a year ago, that when magenta, or, as it is termed in chemical language, rosaniline, is heated with iodide of ethyl, a change is effected, and a substitution product formed, which was termed ethyl-rosaniline. The salts of this new base, unlike magenta, dissolve with a beautiful violet colour, and are capable of affording most remarkable manifestations. The dark violet liquid, on the addition of sulphuric acid, becomes colourless; on adding ammonia the original purple is restored. If hydrochloric acid is added in small quantities, the liquid changes to blue; if in larger quantities, to a brilliant green. When this green solution is thrown into water, so as to dilute the acid, the original violet returns.

When aniline is heated with salts of magenta, purple and blue colours are produced, all of which are now extensively employed in commerce, and afford tints of great brilliancy and beauty. The blue is perfectly insoluble in water, but readily soluble in alcohol, and is capable of dyeing both silk and wool with the greatest facility.

Mr. Nicholson patented a method a few years ago for obtaining a beautiful blue dye, soluble in water, which consisted in heating the phenyl blue in strong sulphuric acid until a drop of the semi-liquid thrown into water was found to be entirely dissolved. This compound, however, although very applicable for silks, refuses to impart its colour to wool, which may be exemplified by immersing two white tassels in the liquid—the silk is immediately dyed, while the wool remains unchanged. The effect is still more striking upon cotton. We have here the letters R. I. (the initials of the Royal Institution) worked in silk upon a cotton ground; after dipping it for a few moments in this bath the letters will become blue, and the cotton continue white.

Aniline green, which has lately become so popular, is produced by the action of aldehyde and some other deoxidizing agents upon rosaniline. This is one of the most charming colours yet discovered, but has not been (as far as its chemical nature is concerned) satisfactorily investigated. To judge of its purity of tint, it is only necessary to compare the commercial greens, prepared by various mixtures of yellow and blue, with the dye in question, to observe the infinite superiority of the latter.

Aniline brown may be formed by the action of chloride of aniline upon either magenta or violet, at a high temperature. Great destruction of colour doubtless takes place, but the brown produced is remarkably beautiful. The compound, however, is not definite, nor can it be classed among the true chemical products derived either from aniline or rosaniline.

It has been observed that magenta base is colourless: this may be

said, probably, of the bases of most of the colours before you. On this white board I have traced the letters composing the word "Aniline" in seven colourless bases derived from that compound. A, in ethylrosaniline; N, in phenyl-violet, approaching indigo in colour; I, in phenyl-blue; L, in aniline-green; I, in azo-phenylamine; N, in chrysaniline; and E, in rosaniline. On converting these bases into salts, which is easily effected by sprinkling them with acetic acid and spirit, the seven letters should be visible in the seven colours of the rainbow —violet, indigo, blue, green, yellow, orange, and red.

I will now throw a beam from the electric lamp upon the specimens of silk on the screen, and it will be observed how much their brilliancy is increased under the influence of that pure and beautiful light. I am indebted to my kind friends, Messrs. Simpson, Maule, and Nicholson, for the various splendid specimens of dye and other aniline products, and to Messrs. Hands, Son, and Co., Coventry, the eminent silk dyers, for the array of silks so kindly furnished me for the illustration of my discourse.

Provisional Protection Granted.

Cases in which a Full Specification has been deposited.

1368. Theodore Faucheux, of Caversham-road, Kentish-town, impts. in rotary magneto-electric machines,—a communication.—*May 18th.*

1410. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in lamps for burning mineral oils,—a communication.—*May 22nd.*

1414. Alexander Hett, of London, impts. in the treatment of clays and other materials with which they are mixed when used in the manufacture of china, porcelain, earthenware, and other like wares, and in ornamenting or decorating china, porcelain, earthenware, and other like wares.—*May 23rd.*

1463. George Gibson Bussey, of Dunn's-passage, New Oxford-street, impd. method of loading and turning over the shells of cartridges, and in the machine used for the same.—*May 27th.*

1494. Hypolite Monier, of Paris, impd. burner for gas, and other lighting apparatus.—*May 31st.*

1552. George Haseltine, of Southampton-buildings, impts. in fuses and projectiles for rifled ordnance,—a communication.—*June 6th.*

1568. George Haseltine, of Southampton-buildings, impd. apparatus for sifting flour and other substances,—a communication.—*June 8th.*

1572. George Haseltine, of Southampton-buildings, impts. in sewing machines,—a communication.—*June 9th.*

[*Cases in which a Provisional Specification has been deposited.*]

1864.

258. William Hiram Higgins, of Luton, Bedfordshire, impd. machinery for shaping hat and bonnet blocks.—*January 28th.*

405. John Garrett Tongue, of Southampton-buildings, impts. in the construction, arrangement, and mode of applying paddle wheels for propelling boats or other vessels,—a communication.—*February 13th.*

440. William Edward Gedge, of Wellington-street, impd. manufacture of barège stuffs,—a communication.—*February 16th.*

477. William Edward Gedge, of Wellington-street, a chemical combustible substance and apparatus to which it is applicable,—a communication.—*February 20th.*

510. John George Hughes, of the Strand, impd. screw propeller, and an impd. application of the motive power to the propelling of boats and steam ships, applicable also to other purposes,—a communication.—*February 23rd.*

550. Thomas Welcome Roys and Gustavus Adolphus Lilliendahl, of New York, impts. in rocket guns and rocket harpoons, and apparatus to be used therewith for the capture of whales, and other purposes.—*Feb. 27th.*

598. Sir John Scott Lillie, of Pall Mall, impts. in apparatus for propulsion by atmospheric pressure.—*March 3rd.*

720. John Peter Booth, of Cork, impd. manufacture of trimming, applicable to the ornamentation of ladies' dresses.—*March 14th.*

722. Nathaniel Neal Solly, of Moseley Hall, near Wolverhampton, impts. in water tuyeres for blast furnaces,—partly a communication.—*March 15th.*

899. William Brookes, of Chancery-lane, impd. mode of rapidly reducing, cementing, and melting iron and other ores, also iron slag or cinders, dross, and scales or crust, to produce directly therefrom steel, or malleable or cast iron,—a communication.

900. Alexander Angus Croll, of Coleman-street, City, impts. in the manufacture of sulphate of alumina.

901. Archibald Turner, of Leicester, impts. in machinery for winding yarns or threads on to quills, spools, and bobbins.

902. Alfred Vincent Newton, of Chancery-lane, impts. in the construction of cartridge and other boxes,—a communication.

The above bear date March 30th.

903. William Milner and Daniel Rowlinson Ratcliff, of Liverpool, impts. in the fastenings to be employed in metallic "safes," or other similar depositories.

904. Thomas Cook, of Coburg-road, Old Kent-road, impts. in the construction of safes or depositories intended to contain valuable property.

905. John Pinchbeck, of Reading, impt. in engines worked by heated air or gases.

906. John Swarbrick, David Swarbrick, Benjamin Swarbrick, and Ormerod Swarbrick, all of Baxenden, Lancashire, impts. in steam boilers.

907. Laug Bridge, of Accrington, impts. in looms for weaving.

908. John Poole, of Riley-street, Chelsea, and Thomas Brown, of Shrubland-road, Dalston, impts. in socks, soles, or feet protectors, to be used loose in boots and shoes, or affixed thereto.

909. Elias Leak, of Longton, Staffordshire, impd. apparatus for collecting or receiving pulverized flint or dust.

910. Henri Adrien Bonneville, of Paris, impts. in telegraphic apparatus,—a communication.

911. Benjamin Greenwood, of Cumberland-place, Westbourne-grove North, impts. in the means or method of curing or preventing smoky chimnies.

913. Alfred Vincent Newton, of Chancery-lane, impd. means of preventing the leakage of barrels, and of rendering packages and fabrics impervious to air and gases,—a communication.

914. Alfred Vincent Newton, of Chancery-lane, impd. manufacture of inking rollers,—a communication.

915. John Henry Smith, of Bexley Heath, impd. apparatus for mounting photographs.

916. George Robert Stephenson and George Henry Phipps, of Great George-street, Westminster, impts. in the construction of locomotive engines and railway carriages, for facilitating their passage round curves,—a communication.

917. James Bathgate, of Edinburgh, impts. in gas meters, and in the machinery or apparatus connected therewith.

918. Thomas Kemp Mace, of Birmingham, impts. in fixed bands or rib holders for umbrellas and parasols; and which said band is also applicable as an ornamental appendage to walking sticks and other purposes.

The above bear date March 31st.

919. William Mayall, John Knott, and William Dennis, all of Mosley, Lancashire, impts. in mules for spinning cotton and other fibrous substances.
920. John Drinkwater, of Dukinfield, impd. application of rotating brushes, and in the mechanism and apparatus connected therewith.
921. William Kilbey, of Anchor-street, Shoreditch, impts. in the apparatus used in the winding and rewinding of silk and other fabrics.
922. Henry Lewis, of Cheapside, impts. in wringing machines; parts of which are applicable to the construction of rollers,—a communication.
923. Richard Archibald Brooman, of Fleet-street, impts. in street railways,—a communication.
924. George Burt, of Birmingham, impts. in machinery for ornamenting metal tubes.
925. William Gray, of Sheffield, impts. in rolling or forging steel or wrought iron in bars to be used as beaters or beating bars upon the drum concaves or breast plates of concaves in thrashing machines.
926. James Kennan, of Dublin, impts. in machinery or apparatus for cutting scrolls, frets, and filigree work.
927. Robert Willacy, of Penwortham Priory, Lancashire, impts. in machinery or apparatus for preparing and supplying food for cattle.
928. Alfred William Pearce, of Dundee, impts. in looms for weaving.
929. John Charles Stovin, of Whitehead's-grove, Chelsea, further impts. in the means of communicating signals from passengers in railway trains to the guards and engine drivers.
930. Paul Haenlin, of Woburn-place, Russell-square, impts. in navigable balloons.

The above bear date April 1st.

931. William Bünger, of Southampton-buildings, impts. in vessels or apparatus for melting sealing wax, glue, or other substances,—a communication.
932. Johann von der Poppenburg, of Birmingham, impts. in projectiles and cartridges for central fire breech-loading fire-arms and ordnance.
933. Thomas Corbett and Robert Harrington, of Birmingham, impts. in the manufacture of letter clips, book markers, paper knives, and clips for suspending stationery, drapery, and pictures, and for other such like purposes.
934. Richard Robert Riches and Charles James Watts, of Norwich, impts. in apparatus applicable to machines for cutting hay, straw, and such like substances.
935. William Cantrill Gollings, of Clarence-road, Kentish-town, impts. in paddle wheels, parts of which are applicable to other purposes.
936. Henry Johnson, of Lincoln's-inn-fields, impts. in the manufacture of postage and other stamps,—a communication.
937. Pierre Joseph Jamet, of Paris, impd. safety tackle for raising and lowering heavy weights.
939. Alfred Lockwood and Alfred Lockwood, jun., of Chester, impts. in the manufacture of bricks, and in the apparatus employed therein.
940. Frederick Brown, of Luton, impts. in kitchen ranges.
941. Charles Vero, of Atherstone, impts. in the manufacture of felt hats.
942. Henry Brook, John Eastwood, and George Brook, all of Huddersfield, impts. in apparatus applicable to furnaces for smelting ores and melting metals.

The above bear date April 3rd.

943. Charles Denoon Young, of Perth, impts. in double-acting lift and force pumps.
944. Richard Nabbs, of John-street, Tottenham-court-road, impts. in locks, and in fixing knobs and spindles to doors and latches.
945. John Richardson Wigham, of Monkstown, Ireland, impts. in the means and apparatus employed for illuminating lighthouses.
946. George Curr Thompson, of Sheffield, impts. in securing the doors of safes and other doors.
947. Henry Jenkins, of Birmingham, impts. in the fastenings for sleeve links, solitaires, and other like purposes.
948. Alfred Illingworth and Henry Il-

lingworth, of Bradford, Yorkshire, impts. in preparing wool and other fibrous substances, and in the apparatus employed therein.

949. William Brookes, of Chancery-lane, impts. in means or apparatus for obtaining motive power by the aid of steam, gas, or other fluids,—a communication.

950. Charles Martin, of Reading, impts. in means or apparatus for effecting the cleansing and polishing of forks.

951. Robert Baynes, of Mansel-villas, Wimbledon, impts. in suction and force pumps.

952. William Clark, of Chancery-lane, impd. machine for rounding and polishing shot, shell, and other balls or spheres,—a communication.

953. Joseph Vaughan, of Birmingham, impts. in steam and atmospheric hammers and presses; which improvements are also applicable to steam engines.

954. William Moody and William James Huband, of Handsworth, Staffordshire, impts. in stringing and tuning pianofortes and other stringed musical instruments.

955. William Edward Newton, of Chancery-lane, impd. apparatus for expressing liquids from pulpy and semifluid substances,—a communication.

956. William Bulstrode, of Cookham Dean, Berkshire, impd. apparatus applicable to steam cultivation.

957. John Player, of Stockton-on-Tees, impts. in the manufacture of balls, blooms, or slabs of malleable iron or steel.

958. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in separating fibre from vegetable materials containing the same,—a communication.

The above bear date April 4th.

960. Adam Millar, of Grove-street, Camden Town, impts. in certain electric telegraphs, part of which invention is applicable to other purposes.

961. Robert Stanley, of Manchester, impd. hat ventilator.

962. John Gay Newton Alleyne, of Alfreton, Derbyshire, impts. in traction engines.

963. Henry Simon, of Manchester, impd. apparatus for separating or sorting and washing ores, minerals, coal, emery, and other substances in a granular or pulverulent state,—a communication.

965. Benjamin Johnson, of Church-street, Camberwell-green, impts. in pianofortes.

966. William Teall, Louis Lepaige, and Edward Thornhill Simpson, of Wakefield, Yorkshire, impts. in the manufacture of lubricating oil and grease,—a communication.

968. George Walter Dyson, of Tinsley, Yorkshire, impd. rabble or bar used in puddling iron.

969. Charles William Lancaster, of New Bond-street, impts. in fire-arms, and in apparatus for extracting cartridges and cartridge cases therefrom.

970. Edward Ritherdon, of Fenchurch-street, impts. in protecting iron ships and other submerged structures from oxidation and corrosion.

971. Frederic Rainford Ensor, of Nottingham, impts. in the manufacture of lace in twist lace machines.

972. Charles Esplin, of Tyer-street, Lambeth, impts. in apparatus for regulating the supply of gas.

The above bear date April 5th.

973. Robert Maynard, of Whittlesford, impts. in machinery for cutting the human hair; the same being applicable for shearing horses.

974. John Brown, of Bolton, impts. in, or applicable to, boilers furnished with pipes for the circulation of water for domestic purposes.

975. John Samuel Watson and Albert Horwood, of King William-street, London-bridge, impts. in conducting electricity for communicating or transmitting signals and alarms in the event of burglary, fire, railway accidents, and other purposes.

976. Edwin Henry Newby, of Cheapside, impd. mode of pointing or tapering the ends of metallic rods or wires; applicable to the manufacture of pins, needles, and other articles where points or tapered ends are required,—a communication.

977. Charles Horton Williams, of Birmingham, impts. in the manufacture of cornice pole and other rings.

978. John Badger, of Worcester, impts. in the manufacture of harrows, cultivators, and other similar agricultural implements.

979. Martin Diosy, of Fenchurch-street, impd. material to be used in combination with, or as a substitute for, coffee,—a communication.

980. George Davies, of Serle-street, Lincoln's-inn, impts. in the means of, and apparatus for, increasing the illuminating power of hydrocarbon oils and gases,—a communication.

981. John Henry Johnson, of Lincoln's-inn-fields, impts. in machinery or apparatus for drilling or boring rocks and other hard substances in tunnelling, mining, and other like operations, parts of which impts. are also applicable to the ventilating of the workings in mines and similar places,—a communication.

982. James Grafton Jones, of Blaina Iron Works, near Newport, impts. in apparatus employed to actuate the valves of engines worked by steam, air, or other fluid.

983. Joshua Ellis, of Dewsbury, Yorkshire, and Charles Walker and William Preston, of Batley Carr, Yorkshire, impts. in machinery for carding wool or other fibrous subsubstances.

984. William Bartram Richards, of New York, U.S.A., impd. mode of preventing corrosion or staining of the surface of glass.

985. Richard Garrett, jun., of Leiston Works, Saxmundham, impd. apparatus for reducing wheat and other straw.

986. Pierre Hugon, of Paris, impts. in gas engines.

The above bear date April 6th.

987. Andrew Muir, of Manchester, impts. in breech-loading fire-arms.

988. George Rydill, of Dewsbury, impts. in steam boilers, steam boiler tubes, sides of steam boilers, flues, and furnaces.

989. Edward Welch, of Vimiera-place, South Lambeth, impts. in fireplaces and flues, and apparatus connected therewith.

990. James Thompson, of Blackburn, impts. in machinery or apparatus to be employed in preparing cotton and other fibrous substances for spinning.

991. Samuel Smith and John William Jackson, of Keighley, Yorkshire, impts. in governors or regulators for steam or other motive power engines.

992. Thomas Wilkes, of Birmingham, impts. in machinery for the manufacture of railway bolts and spikes, and other like articles.

993. Thomas White, of Birmingham, impts. in the manufacture of the handles of nut crackers, lobster crackers, and grape scissors; which said impts. are also applicable to the manufacture of the handles of knives, spoons, and other articles.

994. James Brown, of Aldgate, impd. nail.

995. Henry Edmonds, of Gosport, impts. in apparatus for lighting and ventilating ships, part of which is also applicable for producing fresh water at sea.

996. William Gray, Edward Gray, and John Gray, all of Sheffield, impts. in the manufacture of plough shares, socks or points for ploughs, cultivators, or scurrifurrows, and other implements used in the cultivation of the land where these points are used or required.

997. William Jackson, of Glasgow, impts. in the method of mixing gases and vapour, and in the machinery or apparatus connected therewith.

998. Moses Savery Maynard, of Preston, impts. in machinery for preparing cotton and other fibrous substances.

999. Nathan Gold Kimberley, of Birmingham, impts. in locks.

1000. Thomas Skidmore, of Wolverhampton, impts. in the construction of safes or receptacles for securing and protecting valuable property.

1001. Michael Henry, of Fleet-street, impts. in the mode of, and apparatus for, purifying smoke; which impts. are also applicable to other purposes in which gas or vapour is to be separated from substances combined therewith, or held in suspension therein,—a communication.

The above bear date April 7th.

1003. Henry Joseph Simlick, of Bow, impts. in mechanism applicable to

frame-filling machines for wooden matches, vestas, and vesuvians.

1004. Alfred Homfray, of Halesowen, Worcestershire, impts. in the mode of making or forming the links of iron or steel chains and chain cables, and for machinery to be used therein.

1005. William Weatherley, of Chartham, Kent, impts. in sizing paper, and in the machinery employed therein.

1006. James Isherwood, of Haslingden, Lancashire, impts. in dyeing or printing upon the fabric known as "sail cloth."

1007. George Davies, of Serle-street, impts. in buttons, and in devices for securing the same to fabrics,—a communication.

1008. George Davies, of Serle-street, impd. composition for preventing the fouling of ships and other vessels,—a communication.

1009. Victor Albert Prout, of Manor House, East Moulsey, Surrey, impts. in photographic cameras.

1010. Joseph Debnam, of Tuffnell-place, Essex-road, Islington, impts. in the means of ornamenting linen cuffs and collars.

1011. Andrew George Hunter, of Rock-cliff Hall, near Flint, impts. in the manufacture of soda and potash.

1012. Siegmund Moore, of Liverpool-street, City, impts. in electro-magnetic engines.

1013. Thomas Turton, of Sheffield, impts. in machinery for cutting files.

1014. Jean Baptist Hausman, of St. Pancras, impd. apparatus for supporting and steadying the arm in rifle shooting.

1015. Joseph White, of Lambeth, impd. hand-drilling machine.

The above bear date April 8th.

1016. Allan Stewart, of Talbot-terrace, Westbourne-park, impd. abdominal and scrotal bandage.

1017. Charles François Gheerbrant, of Rosières, France, impd. mode of, and apparatus for, deepening the bottom or bed of rivers, canals, harbours, or other similar places.

1018. Richard Archibald Brooman, of Fleet-street, impd. method of forming tapered rods and bits,—a communication.

1019. Robert Fergusson, of Davy-hulme, and Walter Ralston, of Manchester, impts. in machinery for finishing yarns or threads.

1020. William Brooks, of Bristol, impts. in heating files and file blanks.

1021. George Voigt, of Aldershot, impd. mechanical arrangements for stopping or retarding railway carriages, waggons, and trucks.

The above bear date April 10th.

1022. James John Myers, of Southampton, impd. compensating wheel to be used with locomotives, carriages, and other vehicles on railway and tram roads, in conjunction with or without the wheels now used, in order to obtain at curves and other parts of the road a rolling instead of a sledging motion, now effected by wheels in present use, on railway and other tram roads.

1023. Charles Vaughan, of Birmingham, impts. in the manufacture of iron and steel.

1024. Stephen Wright, of Smethwick, impts. in carriage and other wheels, and in connecting or fixing the said wheels to their axle-boxes.

1025. William Clark, of Chancery-lane, impts. in horse-shoes,—a communication.

1026. David Payne, of Otley, Yorkshire, impts. in printing machinery.

1027. Richard Archibald Brooman, of Fleet-street, impts. in apparatus for storing petroleum and other inflammable liquids of less specific gravity than water,—a communication.

1028. Richard Archibald Brooman, of Fleet-street, method of applying suction and blast, and the apparatus employed thereon,—a communication.

1029. John Henry Johnson, of Lincoln's-inn-fields, impts. in steam generators, applicable also to condensers or coolers,—a communication.

1030. John Henry Johnson, of Lincoln's-inn-fields, impts. in the means for communicating between the passengers and guards of railway trains, or between two or more different situations,—a communication.

1031. William Edward Newton, of Chancery-lane, impts. in the construction of submarine telegraph cables, and

in the mode of submerging or laying them in the water,—a communication.

1032. Archibald Turner, of Leicester, impts. in looms for weaving.

1033. Lawrence Barnett Phillips, of Hunter-street, Brunswick-square, impts. in watches.

1034. Benjamin William Leslie Nicoll, of Oxford-street, impd. flexible spring waist for boots and shoes.

1035. Josiah Dudley, of Coventry, impts. in couplings for railway carriages, waggons, trucks, and other vehicles.

The above bear date April 11*th*.

1038. John Haworth, of Mode Wheel House, Manchester, impd. application of rotating brushes to the grooming or cleaning of horses and other quadrupeds.

1039. Henry Bridson, of Bolton, impts. in clamps for stretching frames and other purposes.

1041. Frederic Pelham Warren, of Southsea, impd. cooking utensil.

1042. Henry Sikes, of Rushfield, near Almondbury, Yorkshire, and George Jarmain, of Huddersfield, impts. in treating wool, in order to cleanse it from burrs, seeds, and other foreign matters.

1043. John Walker, of Birmingham, impts. in door locks and latches.

1045. John Matthias Hart, of Cheapside, impts. in bolting and locking arrangements for safe and other doors.

1046. Thomas Jefferson Mayall, of Roxbury, Massachusetts, U. S. A., impts. in fire-arms, and in cartridges to be used therewith, and with other fire-arms.

1047. Frederick Bapty and Edward Brydges Sayers, of Dublin, impd. guide, applicable to sewing machines.

1048. George Jackson, of Westhorpe, Bucks, impts. in rests or supports for cues or other similar instruments used for billiards or other similar games.

1049. John Solomon Bickford, of Camborne, Cornwall, the manufacture of an improved safety fuse.

1050. William Edward Newton, of Chancery-lane, impts. in elastic binders for boots and shoes,—a communication.

1051. Alfred Vincent Newton, of Chancery-lane, impd. construction of Giffard's injector,—a communication.

1052. Henry Leonhardt, of St. Gall, Switzerland, a motive-power engine.

The above bear date April 12*th*.

1053. George Rosselet, of Paris, method of obtaining and applying water as a motive power for propelling ships, boats, and other vessels.

1054. George Mountford, of Grasscroft, Yorkshire, impd. metallic preparation or composition for cleaning, sharpening, burnishing, and grinding articles of cutlery, edge tools, or cutting instruments, and for grinding the cards or rollers of carding engines and the surfaces of cylinders, and covering rollers for various kinds of woollen and cotton machinery.

1055. Albert Westhead, of St. Mary Axe, City, impts. in apparatus for signalling on railway trains.

1056. John Chubb, of St. Paul's Churchyard, and Robert Goater, of Wood-street, King-square, impts. in iron safes and strong rooms.

1057. William Speakman Yates, of Leeds, impts. in machinery for folding fabrics for pressing.

1058. Charles Forster Cotterill, of Cannock, Staffordshire, impts. in pipes for conveying water and gas, and for other like purposes; and a new or improved composition for joining the said pipes and other similar pipes.

1059. Seth Dawson, of Springfield, John Burgess, of Saddleworth, both in Yorkshire, and John Wilson, of Mossley, Lancashire, impts. in metallic pistons.

1060. James Rippon, of Sheffield, impts. in apparatus for lubricating spindles, shafts, or other frictional surfaces,—a communication.

1061. Christopher Turner, of Bingley, Yorkshire, and Thomas Room, of Burnley, Lancashire, impts. in looms for weaving.

1062. Richard Archibald Brooman, of Fleet-street, impts. in apparatus for feeding boilers, raising water, and propelling vessels,—a communication.

1063. Thomas Bennett, of Birmingham,

impts. in the manufacture of hoop or narrow strip iron.

1064. William Beardmore, of Parkhead, Lanark, N.B., impts. in the arrangement of furnaces used for puddling and re-heating iron, the generation of steam, and other similar purposes.

The above bear date April 13th.

1065. John McDowall, of Johnstone, Renfrew, N.B., impts. in apparatus for shaping corks.

1066. John Minton Courtauld, of Bocking, Essex, impd. safety apparatus for steam boilers.

1068. William Clark, of Chancery-lane, impts. in the manufacture of a compound or material to be used as a substitute for India-rubber,—a communication.

1069. Thomas Edward Harding, of Circus-street, Marylebone-road, impd. table and support for invalids.

The above bear date April 15th.

1070. Mark Smith, of Heywood, Lancashire, impts. in looms for weaving.

1071. Alexander Henry, of Edinburgh, impts. in breech-loading fire-arms.

1072. Thomas Newbigging and Alexander Hindle, of Bacup, impts. in wet gas meters.

1073. James John Matthewson, of Claremont-place, Rotherhithe, and Heinrich Louis Rudolph Schlee, of Victoria-villas, Penge, impts. in rotatory aerial swings.

1074. Louis de St. Céran, of Paris, impts. in gas ammoniacal engines.

1075. Edward Morgan and George Henry Morgan, of Grand Junction-terrace, Edgware-road, impts. in apparatus for covering railway trucks, or vans, and other carriages.

1076. Joseph Dougan, of Coed Talon, near Mold, North Wales, impts. in apparatus for distilling hydrocarbons from coals, schists, and other minerals.

1077. Albert Ward Hale, of New York, impts. in machines for cutting or mincing meat, suet, and other substances.

1078. George William Garrood, of Woolmore-street, Mile-End, impts. in the means of communicating and signalling between the passengers, guards, and drivers of railway trains.

The above bear date April 17th.

1079. Frederick Collier Bakewell, of Haverstock-terrace, Hampstead, impts. in cushions for steam cylinders,—a communication.

1080. John Crosbie Aitken Henderson, of Compton-street, Clerkenwell, impd. manufacture of ladies' skirts.

1081. John Jones Jenkins, of Swansea, impts. in the manufacture of tin and terne plates.

1082. John Todd, of Greenwich, impd. machine for straightening, bending, curving, and circling beams, bars, and plates of iron or other metals.

1083. William Bedder, of Saltash, Cornwall, impts. in the construction of ships or vessels, or cars to float on water.

1084. Thomas Whitehead and Nicholas Nussey, of Holbeck, Leeds, impts. in machinery for combing, preparing, and drawing wool or other fibrous material.

The above bear date April 18th.

1085. Joseph Gardner, Richard Lee, and George Henry Wain, of Liverpool, and Samuel Hargrove, Charles Hargrove, and Samuel Hargrove, jun., of Birmingham, impts. in the manufacture of malleable iron sheaves and bushes for pulley blocks.

1086. James Edward Hyde Andrew, of Audenshaw, impts. in looms for weaving.

1087. Richard Archibald Brooman, of Fleet-street, impts. in machinery for the manufacture of lace,—a communication.

1088. Ralph Augustine Jones and Joseph Hedges, of Aylesbury, impts. in, and apparatus for, communicating intelligence by means of electricity.

1089. John Merritt, of Brooklyn, New York, impts. in inkstands,—a communication.

1090. William Riddell, of Crosby Hall Chambers, Bishopsgate-street, impts. in the means of covering railway trucks, vans, and other carriages.

1091. Fredric William Gilbert, of Sheffield, impts. in 'pulleys' used by brewers and others for lifting and lowering weights into and out of carts, waggons, or trucks.

1092. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts.

in breech-loading fire-arms,—a communication.

1093. Maurice Vogl, of Sambrook-court, Basinghall-street, impts. in machinery for cutting and dressing stones and other hard substances,—a communication.

The above bear date April 19th.

1096. Henry Kindon Taylor, of King-street, Covent-garden, impts. in indicators and fastenings for water closets, and other purposes.

1097. David Hancock, of High Wycombe, Bucks, and Thomas Evans, of Eastcheap, impts. in apparatus for communicating and signalling between passengers, guards, and drivers of railway trains by day or by night.

1098. Ernest Smith and Christian Siebert, of Glasgow, impts. in obtaining violet coloring matters.

1099. Meguerditch Houssepain, of Manchester, impts. in pumps,—a communication.

1100. Thomas Hampton and James Abbott, of Sheffield, impts. in casting and working so-called 'Bessemer' steel ingots.

1101. William Clark, of Chancery-lane, impts. in taps or stop-cocks,—a communication.

1102. Frederick Augustus Abel, of the Royal Arsenal, Woolwich, impts. in the preparation and treatment of gun cotton.

1103. William Hale, of John-street, Adelphi, impts. in rockets.

1104. David Greig, of Leeds, impts. in machinery for cultivating land,—partly a communication.

1105. William Beaven, of Dilton Farm, Westbury, impts. in apparatus for screening, sifting, or riddling corn, grain, and seed.

1106. William Robinson, of Watling-street, London, impts. in jacks used when roasting and baking.

1107. Henry Caudwell, of Shillingford, Oxfordshire, impts. in the construction of ships of war and floating batteries; parts of which improvements are applicable to land fortifications.

1108. John Yeldham Betts, of Coventry, impts. in the baking of bread, biscuits, and other farinaceous articles.

1109. Francis Wise, of Chandos-chambers, Adelphi, impts. in gas regulators and valves for the same,—a communication.

The above bear date April 20th.

1110. Thomas Greaves and John Skirrow Wright, of Birmingham, impts. in the manufacture of buttons.

1111. David Simson Buchanan, of Liverpool, impts. in protecting letters, numerals, and ornamental designs on glass.

1112. Edward Thomas Hughes, of Chancery-lane, impd. packing for steam cylinders, stuffing boxes, and closed vessels, containing water, air, or gases, and for other similar purposes,—a commmunication.

1114. William Day, of Burton Latimer, near Wellingborough, impts. in wheels, and the manner of applying the same to railway carriages for passengers and goods traffic, as also the leading wheels for locomotives.

1115. Abraham Cohn Herrmann, of Berlin, impd. balance with index for weighing railway passengers' luggage.

1117. William Scarratt and William Dean, of Longton, impts. in taking impressions from the grain of wood, and in transferring the same on to various surfaces.

1119. George Whillock, of Birmingham, impts. in oiling cans.

1120. Henry Edward Newton, of Chancery-lane, impts. in invalid carriages,—a communication.

1121. George Betjemann, George William Betjemann, and John Betjemann, of Pentonville, impts. in cases or receptacles for matches, stamps, cards, and other articles.

1122. Richard Canham, of Clerkenwell, impts. in machinery for moulding and making cores for moulding or casting metals.

1123. Collinson Hall, of Navestock, Essex, impts. in engines, machinery, and implements employed in ploughing and tilling land.

The above bear date April 21st.

1124. Ormrod Coffeen Evans, of Birmingham, impts. in digging machinery.

1125. Edward Lord, of Todmorden, impts. in machinery for preparing

and spinning cotton and other fibrous substances.

1126. Emile Stanislas Beaux and Edward Pannifex, of Paris, process of tanning leather and other skins.

1127. Joshua Henry Wilson, of Cornholme Mill, near Todmorden, impts. in spools or bobbins to be used in certain frames for preparing fibrous materials for spinning.

1129. Charles James Keenan and John Alexander Keenan, of Puteaux, France, impts. in the manufacture of articles of lace or net fabric.

1130. Alfred Grainger, of Hall-place, Kennington, and Charles Mitchel Girdler, of Saville-row, Walworth-road, impts. in the manufacture and application of devices and representations to tombstones, and in other public or exposed situations, for various purposes.

1131. William Bünger, of Southampton-buildings, impts. in the construction of the permanent way of railways,—a communication.

1132. George Haseltine, of Southampton-buildings, impd. implement for removing corks from the interior of bottles and other vessels,—a communication.

1133. Alfred Vincent Newton, of Chancery-lane, impts. in the fitting of surface condenser tubes, and in the tools to be used therein; and in the means of retarding corrosion in steam boilers, a communication.

1134. James Howard and Edward Tenny Bousfield, of Bedford, impts. in motive power machinery for cultivating land; part of which impts. is also applicable to driving machinery generally.

The above bear date April 22nd.

1135. Welburn Williamson, of High Holborn, impts. in constructing portable hot rooms or chambers for drying cloths and other articles.

1136. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in breech-loading fire-arms,—a communication.

1138. Richard Henry Dart, of Blackman-street, Borough, impts. in paddle wheel propellers, adapted for propelling vessels in water.

1139. Henry Charles Butcher, of Wellington-street, Strand, impd. cigar cutter.

1140. William Edward Gedge, of Wellington-street, impd. apparatus for administering nourishment to the sick or infirm,—a communication.

1142. Charles Eastwood, of Ravensthorpe, Yorkshire, and George Eastwood, of Honley, near Huddersfield, impts. in self-acting temples for looms.

1143. John Joseph Parkes, of London-street, Paddington, impts. in apparatus for making communications from one part of a building to another.

1144. William Clark, of Chancery-lane, impts. in washing or steeping and bleaching textile or fibrous materials, —a communication.

1145. Aaron Atkins, of Turnham Green, impd. shoe or sandal for facilitating the art of swimming.

1146. John Frederik Christian Carle, of Hamburg, impts. in breech-loading needle guns, for military and other purposes,

1147. William Edward Newton, of Chancery-lane, impts. in penholders or cases,—a communication.

The above bear date April 24th.

1149. Nicholas Sibly, of St. Laurence, near Bodmin, impd. apparatus for pouring and decanting liquids.

1150. Thomas Walker, of Birmingham, impts. in means or apparatus for measuring the flow or passage of liquids; which impts. are also applicable in obtaining motive power.

1151. George Davies, of Serle-street, Lincoln's-inn, impd. apparatus for securing buttons to fabrics,—a communication.

1152. Richard Archibald Brooman, of Fleet-street, impts. in smoke-consuming furnaces,—a communication.

1153. John Nurthall Brown, of Handsworth, and Thomas Deykin Clare, of Birmingham, impts. in the manufacture of iron, and in preparing fuel to be used in the manufacture and melting of iron.

1154. John Nurthall Brown, of Handsworth, and Thomas Deykin Clare, of Birmingham, impts. in paints or compositions for coating and preserving metallic and other substances from oxidation and decay.

1155. John Wilkinson, the younger,

of Hunslet, Yorkshire, impd. means or apparatus for printing felts, floor-cloths, carpets, and woven fabrics.

1156. Claude Jacquelin, jun., of Paris, impd. means or apparatus for gaining or acquiring motive power.

1157. William Elder, of Dundee, impts. in steering ships or vessels, and in the machinery or apparatus connected therewith.

1158. John Townsend Bucknill, of Chatham, impts. in the construction of railway rails and wheels.

1159. John Collins Wickham, of Armagh-road, North Bow, and Auguste Edward Deiss, of Bow-bridge, impts. in the manufacture of waterproof fabrics, and in apparatus to be employed therein.

1160. William Oxley, of Manchester, impts. applicable to rollers of machinery for preparing and spinning fibrous substances; which impts. are also applicable to other rollers which are pressed towards each other.

1161. William Clark, of Chancery-lane, impts. in the manufacture of soluble and assimilable superphosphates of lime, by the application of phosphoric acid and acid phosphates,—a communication.

1162. William Husband, of Hayle, Cornwall, impts. in securing or fastening wooden planking to iron frames in ships or vessels, and also to the outside of iron ships.

The above bear date April 25th.

1164. Thomas Dixon Whitehead, of Birmingham, impts. in fire escapes and portable ladders.

1165. Charles William Heaven, of Birmingham, impd. fastening for fastening articles of dress; which said fastening is also applicable to the joining of belts and bands, and to other like purposes.

1166. John Fairweather and William Fairweather, of Manchester, impts. in sewing machines.

1167. George Mumby, of Wareham-street, Hoxton, impts. in machinery for sewing and embroidering.

1168. François Dominique Pierre Jacques Cabasson, of Paris, impts. in apparatus for disintegrating vegetable and animal substances.

1169. Richard Archibald Brooman, of Fleet-street, impd. method of conditioning or preparing fibres, threads, and fabrics, and apparatus to be employed therein,—a communication.

1170. John Cunningham, of Liverpool, impts. in the construction of fire-proof buildings.

1171. John Alexander Rowland, of Hampton Wick, impts. in photographic cameras.

1172. James Dodge, of Manchester, impts. in file-cutting machines.

1173. George Tomlinson Bousfield, of Loughborough-park, the manufacture of a new resinous gum or balsam, —a communication.

1174. William Henry Smith, of St. Ann's-gardens, Haverstock-hill, impts. in photographing upon wood, and in the preparation of wood, canvas, silk, glass, and other substances, for the purpose of receiving and retaining impressions.

The above bear date April 26th.

1175. Joseph Wilson Lowther, of Manchester, impts. in apparatus for lubricating frictional surfaces, and in the lubricant to be employed therewith.

1176. Joseph Tangye, of Birmingham, impts. in hydraulic pulling jacks.

1177. James Carr, of Birmingham, impts. in breech-loading fire-arms and ordnance, and in projectiles.

1178. Henry Walker Wood, of Cardiff, impts. in machinery for reducing friable substances to powder.

1179. Samuel Harvey, of Clerkenwell, impts. in machinery for cutting or shaping masts, spars, and other beams and articles of wood.

1181. Joseph Frederick Feltham, of Aldersgate-street, impt. in mallets used in the game of croquet and other similar games.

1182. Richard Archibald Brooman, of Fleet-street, impd. apparatus for charging and closing cartridge cases, —a communication.

1183. William Balk, of Emmerberg, Hanover, impts. in furnaces used for smelting and melting iron and other metals.

1184. Alfred Grainger, of Hall-place, Kennington, and Charles Michael Girdler, of Saville-row, Walworth-road, impts. in the production of

portraits or likenesses on certain materials by means of photography.

1185. William Edward Newton, of Chancery-lane, impts. in artificial arms and hands,—a communication.

1186. Dundas Simpson, of Airdrie, Lanark, N.B., impts. in furnaces.

The above bear date April 27th.

1187. Thomas Charles March, of Ambassador's Court, St. James's Palace, impd. contrivances to facilitate the arrangement of flowers and leaves.

1189. Arthur Charles Henderson, of Charing-cross, impts. in water wheels,—a communication.

1190. Edward McNally, of Manchester, impts. in machinery or apparatus for rolling or shaping metallic articles of irregular form, such as "file blanks," and similar articles.

1191. Julian Bernard, of Lincoln's-inn-fields, impts. in apparatus for raising water and other fluids, and in raising and lowering such apparatus.

1192. Julian Bernard, of Lincoln's-inn-fields, impts. in boring or excavating and blasting rocks and minerals, and in the treatment of the tools employed therein.

The above bear date April 28th.

1193. Robert Ferrie, John Murray, and Adam Wilson, of Paisley, impts. in dyeing yarns.

1194. Walter Henry Tucker, of Southampton-street, Strand, impts. in locks and lock furniture.

1195. Andrew Wyllie and John McFarlane Gray, of Liverpool, impts. in steam engines relating to valve motions, governor, and drain pipes.

1196. Charles Gammon, of Cloak-lane, London, impts. in tablets, tickets, or instruments to be used when drawing lots and prizes, and for such like purposes.

1197. Lewis Wells Broadwell, of St. Petersburg, impts. in breech-loading guns.

1198. Thomas White, of Camden-town, impts. in apparatus employed in the re-burning of animal charcoal.

1199. George Augustus Huddart, of Brynkir, impd. manufacture of buttons.

1200. George Pomeroy Dodge, of Upper Thames-street, impts. in pickers for looms.

1201. William Clark, of Chancery-lane, impts. in locks and other fastenings,—a communication.

1203. William Leatham, of Leeds, impts. in machinery or apparatus for working or cutting coal or minerals, and for compressing or exhausting air to be employed therein, or for other purposes; some parts of which apparatus are also applicable to upright shafts, and other parts for regulating the flow or discharge of steam or other elastic fluids.

1204. Francis Gregory, of Manchester, impts. in machinery or apparatus employed in breweries and distilleries.

1205. Jean Guttman, of Paris, impts. in spectacles, opera glasses, telescopes, and similar apparatus,—a communication.

The above bear date April 29th.

1206. David Yoolow Stewart, of Glasgow, impts. in making moulds for casting pipes and other articles of various sizes.

1207. Emile Della-Noce, of Turin, impts. in fire-arms.

1208. Henry Bessemer, of Queen-street-place, London, impts. in the manufacture of pig iron or foundry metal, and in making and treating castings of such metal.

1209. George Johnson, of Wandsworth, impts. in iron fortifications, such improvements being applicable to the construction and protection of ships and floating batteries.

1211. John Blackie, jun., of Lincoln's-inn, impts. in igniting the fuses of shells,—a communication.

1212. Daniel Rankin, of Greenock, impts. in marine steam engines.

1213. John Charles Davis, of Leadenhall-street, impts. in knife cleaning machines.

1214. Walter Thomas Whitmore Jones, of South Audley-street, impd. croquet stand.

1215. Morris West Ruthven, of Harlow-villas, East India-road, impts. in propelling vessels.

1216. William Edward Wiley, of Graham-street, Birmingham, impts. in ever-pointed pencils.

1217. William Watts, of Nottingham,

and John Joseph Cooper, of Bloomsbury-market, impts. in mangles.

1218. William Edward Newton, of Chancery-lane, impts. in the manufacture of flock fabrics,—a communication.

1219. William Edward Newton, of Chancery-lane, impd. manufacture of waterproof fabric,—a communication.

1220. Arthur Howard Emerson and Robert Fowler, of Mildmay-park, Stoke Newington, impts. in the manufacture and application of glass and other vitreous compositions.

1221. Thomas Frederick Cashin, of Sheffield, and Joseph Felix Allender, of Park-gate, near Sheffield, impts. in the means of, and apparatus for, puddling iron.

1222. Joseph Felix Allender, of Park-gate, near Sheffield, and Thomas Frederick Cashin, of Sheffield, impts. in fastenings for driving bands, straps, belts, harness, or other such like purposes.

The above bear date May 1st.

1223. John Henry Johnson, of Lincoln's-inn-fields, impts. in self-acting alarms for indicating excess of heat or cold; parts of which impts. are applicable to the transmission of messages,—a communication.

1224. Rest Fenner, of Red Lion-court, Fleet-street, impts. in embossing presses to facilitate the operation of relief coloring on envelopes, note paper, and other similar articles of stationery.

1226. Thomas Russell, of Wednesbury, impts. in valves, for liquids, steam, and gases.

1227. Francis Wise, of Chandos-chambers, Adelphi, mode of obtaining decoctions, and apparatus for carrying the same into effect,—a communication.

1228. William Edward Newton, of Chancery-lane, impts. in folding beds and bedsteads,—a communication.

1229. Thomas Allcock, of Birmingham, impts. in finishing and polishing metal tubes and rods, and in apparatus or machinery to be employed therein.

1230. Charles William Siemens, of Great George-street, Westminster, impts. in the means and apparatus for regulating the power and velocity of machinery or apparatus in motion.

1231. Jules Catillon, of Hatton-garden, impd. self-supplying pen.

The above bear date May 2nd.

1234. Edward Thornton Read and John Brough Fyfe, of Ardrishaig, Argylle, N.B., impts. in apparatus for receiving the thrust of screw-propeller and other revolving shafts.

1235. Peter Armand Le Comte de Fontainemoreau, of Paris, apparatus for ascertaining the degree of torsion and resistance in the threads of textile substances,—a communication.

1236. Magloire Honoré Beguin, of Paris, impts. in the manufacture of pen-holders.

1237. Peter Armand Le Comte de Fontainemoreau, of Paris, illuminating apparatus for burning petroleum,—a communication.

1239. William Clark, of Chancery-lane, impts. in the means and apparatus used for stretching woven fabrics and other materials,—a communication.

1240. John Henry Johnson, of Lincoln's-inn-fields, impts. in steam generators and engines, and in apparatus for feeding steam generators, —a communication.

1241. William Edward Gedge, of Wellington-street, impd. fan or exhaust for thrashing machines,—a communication.

1242. Carl Gustav Lenk, of Dresden, impd. process for purifying water.

The above bear date May 3rd.

1244. Edward Grainger Smith, of Great Sutton-street, Clerkenwell, impd. apparatus for shelling peas and beans, stoning fruit, and other similar purposes.

1246. John Stalkartt, of Dover, impts. in ploughs.

1247. George Redrup, of Loughborough, impts. in machinery or apparatus for cutting cylindrical or conical articles.

1248. Frederick Caldwell, of Loughborough, impd. machine or apparatus for tying or winding strings or

threads upon a certain part or parts of hanks of cotton, silk, linen, thread, worsted, merino, or other yarn, previous to dyeing the same.

1249. Josiah Hampton, of Loughborough, impd. refrigerator and condenser.

1250. William Roberts, of Millwall, impts. in shackles or links for connecting chain cables and other chains.

1251. John Lilley, of Bancroft-road, Mile-End, impts. in ship and other compasses.

1252. Alexander Mackie, of Warrington, and Henry Garside and James Salmon, of Manchester, impts. in machinery for distributing printing type.

1253. Thomas Wood, of Manchester, impts. in, or applicable to, marine condensing steam engines.

The above bear date May 4th.

1254. George Peel, jun., of Manchester, and Isaac Mason, of Sale, Cheshire, impts. in hydraulic presses for compressing cotton and other substances.

1255. William Henderson, of Glasgow, impts. in extracting copper and several other metals from certain ores of these metals.

1257. Thomas Jefferson Mayall, of Roxbury, Massachusetts, U.S.A., impts. in the manufacture or treatment of India-rubber or gutta-percha, or compounds thereof; applicable to the production of stereotype plates and other forms.

1258. Alexander Horace Brandon, of Paris, impts. in machinery for transmitting and receiving signals,—a communication.

1259. Charles Lamport, of Workington, Cumberland, impts. in the construction of, and mode of supplying fuel to, fire-grates, stoves, and the furnaces of locomotive and other steam boilers.

1260. Joseph Mitchell, of Inverness, impts. in constructing roads and streets.

1261. Joseph Wadsworth, of Macclesfield, Cheshire, and Henry Dusset and James McMurdo, of Manchester, impts. in jacquard and indexing machines.

1262. James McGlashan, of Dundee, impts. in the preparation of jute, hemp, flax, and other fibrous materials, and in the machinery or apparatus employed therein.

1263. Solomon Bennett, of East Lee, Kent, impts. in brewing, distillation, the production of vinegar, and the extract of malt and other grain.

The above bear date May 5th.

1264. William Edward Newton, of Chancey-lane, impts. in steam engines,—a communication.

1265. Sanders Trotman, of Lyme-street, Camden-town, impts. in the means of communication between the passengers and guard, or the guard and driver, of railway trains.

1266. Israel Swindells, of Wigan, impts. in the manufacture of coal gas.

1267. John Hurt and Henry Tonge, of Sowerby-bridge, near Halifax, impts. in apparatus for grinding corn, seeds, minerals, or any other substance ground on the flat surface of a stone.

The above bear date May 6th.

1262. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in apparatus for illuminating,—a communicaton.

1268. William Charles Cropp, of Oatlands, Clapham, impts. in reflecting lamps.

1270. James Buchanan, of Liverpool, impts. in furnace fire-gates.

1272. John Henry Johnson, of Lincoln's-inn-fields, impts. in apparatus for measuring spirits,—a communication.

1273. John Casey, of Dublin, impts. in window sashes and frames, whereby the sashes may be removed and applied at pleasure; part of which improvements is also applicable to sashes as ordinarily constructed.

1274. John Henry Johnson, of Lincoln's-inn-fields, impts. in safety lamps,—a communication.

The above bear date May 8th.

1275. Robert Barlow Cooley, of Northampton, impts. in the manufacture of elastic, knitted, or looped fabrics.

1276. Stephen Law and Joseph Law, of Wolverhampton, impts. in breech-loading fire-arms.

1277. Patrick Welch, of New York,

U.S.A., impts. in machines for dressing and finishing printers' types.

1278. John Cornelius Craigie Halkett, of Crammond House, Mid-Lothian, N.B., impd. composition for coating iron or other vessels, and for other similar purposes.

1279. Joe Green Hey, of Cleckheaton, and Valentine Savory, of Hartishead-cum-Clifton, Yorkshire, impd. self-acting apparatus for, and means of, extinguishing fires.

1280. Edward Taylor Bellhouse and William John Dorning, of Manchester, impts. in hydraulic presses for packing cotton and other materials or substances, and in the boxes for containing the same.

1281. James Gorton, of Manchester, impts. in the manufacture of a certain description of woven fabric, called "Turkish towelling."

1282. Ralph Hart Tweddell, of Newcastle-on-Tyne, impts. in means or apparatus for fixing or tightening the ends of boiler and other tubes, and in cutting the ends or other parts of such tubes.

1283. Thomas Jefferson Mayall, of Roxbury, Massachusetts, U.S.A., impts. in door and other mats; part of which impts. is also applicable to brushes and brooms, and to producing card or tooth surfaces employed in operating on various fibrous substances.

1284. George Hartley, of Aldermanbury, impts. in fasteners for stays or corsets, or other articles of dress.

1285. Samuel Hudson, of Dublin, impd. safety stirrup for ladies' and gentlemen's riding saddles.

1286. John Henry Johnson, of Lincoln's-inn-fields, impts. in the manufacture of paraffin candles,—a communication.

1287. William Jackson, of Glasgow, impd. method of mixing gases and vapour, and in the machinery or apparatus connected therewith.

1289. John Charles Conybeare, of Couldon Grange, near Croydon, impts. in breech-loading fire-arms and cartridges.

The above bear date May 9th.

1290. Stephen Leedham Fuller and Arthur Fuller, of Bath, and Charles Martin, of Duke-street, Adelphi, impd. carriage step.

1291. Daniel Adamson, of Newton Moor Iron Works, near Manchester, impts. in machinery for drilling boiler and other plates of metal, and for rivetting them together.

1292. William Edward Broderick, of Fenchurch-street, impts. in churns,—a communication.

1293. Patrick O'Hagan, of Astor, near Birmingham, impts. in breech-loading fire-arms.

1294. Herbert William Hart, of the Strand, impt. in buttons, and means of attaching the same.

1295. David Hartley, of Oldham, impts. in the manufacture of "moulds" for metallic castings having a cylindrical form.

1296. Edward Myers, of Millbank-row, Westminster, impts. in wet gas meters.

1297. John Forbes, of Perth, N.B., impts. in drying malt and grain, and in the machinery or apparatus connected therewith.

1298. James Melvin, of Prinlaws, Fife, N.B., impts. in jacquard machines.

1299. Peter Brush, of Leith, and Robert Irvine, of the Magdalene Chemical Works, near Musselburgh, impts. in ornamenting candles.

1300. Julian John Révy, of Grosvenor-street, Eaton-square, impts. in the manufacture of gun-cotton cartridges for cannon and small arms.

1301. William Joseph Rice, of College-place, Chelsea, impts. in machinery for obtaining motive power.

1302. Robert Hadfield and Jabez Shipman, of Sheffield, impts. in metal ribs for umbrellas and parasols.

1303. Stanislas Pokutynski and Michel Mycielski, of Paris, impts. in the mode of, and apparatus for, obtaining and applying motive power.

The above bear date May 10th.

1304. James Goodwin, of Ardrossan, N.B., impts. in casting iron girders, and in apparatus therefor.

1305. John Henry Johnson, of Lincoln's-inn-fields, combined safety valve regulator, pressure gauge, water indicator, alarm and "blow-off," for steam generators,—a communication.

1306. William Tijou, of Great George-street, Westminster, impts. in securing

the rails of the permanent way of railways.

1307. William Jamieson, of Ashton-under-Lyne, impts. in power looms for weaving and in apparatus connected therewith.

1308. Joseph Rock Cooper, of Birmingham, impts. in breech-loading fire-arms, and in cartridges for breech-loading fire-arms.

1309. Thomas Jefferson Mayall, of Roxbury, Massachusetts, U.S.A., impts. in the manufacture of hose and other flexible tubing; which impts. are also applicable in uniting surfaces of india-rubber, gutta-percha, or of compounds thereof, to each other, or to woven or other fabric or material for other purposes.

1310. Joseph Bennett, of Sheffield, impts. in the manufacture of iron and steel.

1311. George Mountford, of Grasscroft, Yorkshire, and Edward Worrall, of Upper Mill, Yorkshire, impd. apparatus for cutting, turning, and smoothing metal pipes and the surfaces of bolts, rods, or spindles.

1312. Demas Ellis and Matthew Hillas, of Dudley-hill, Bradford, impts. in apparatus employed in weaving brocaded and ornamental fabrics.

1313. Alexander Parkes, of Birmingham, impts. in the manufacture of parkesine, or compounds of pyroxyline, and also solutions of pyroxyline, known as collodion.

The above bear date May 11th.

1314. Etienne Lucien Girard, of Paris, impd. machinery for fulling fur hats or felt hats,—a communication.

1316. Thomas Smith and Henry James, of Manchester, impd. woven fabric.

1317. James Hesford, of Bolton, impts. in machinery for stretching cotton and other fabrics or materials.

1318. George Haseltine, of Southampton-buildings, impts. in the manufacture of boots and shoes,—a communication.

1319. Henry Ransford, of Brompton, impts. in treating rice and other grain for the manufacture of starch, also to prepare them for use as food, and for other purposes.

1320. Spencer Thomas Garrett, of Stoke-on-Trent, impt. in stoppers and flasks, bottles, and other similar vessels.

1321. Richard Winder, of Abingdon-street, Westminster, impd. method of, and apparatus for, laying single linearticulated railways, and a method of propelling thereon, particularly applicable for agricultural purposes.

1322. William Chubb and Solomon Fry, of Bristol, impts. in the means or method of effecting communication between passengers, guard, and engine driver of railway trains whilst in motion.

1323. Richard Edward Donovan, of Court Duffie, and Daniel O'Brien, of Dublin, impts. in the means and apparatus for effecting traction on railways and roads where traction is used.

1324. William Hewitt, of Brewer-street, Pimlico, impd. composition for preventing incrustation in steam boilers.

1325. George Simmons, of Holborn, and George Walter Simmons, of New Turnstile, impts. in the means and method of producing lithographic impressions, and in the apparatus connected therewith.

1326. John Eddy, of Kennford, Devonshire, impts. in ploughs.

1327. Thomas Davis, of Clapham, impts. in vessels for containing blacking, polishing oils, and other similar materials, and in apparatus connected therewith.

The above bear date May 12th.

1328. Thomas Craig, of New Oxford-street, impts. in breech-loading fire-arms and ordnance, and in apparatus connected therewith.

1329. Thomas Parkinson and William Snodgrass, of Blackburn, impts. in stillages, stands, or supports for barrels, casks, or other similar vessels.

The above bear date May 13th.

1330. Alexander Weir, of Greenock, impts. in water gauges and cocks.

1331. James Key Caird, of Dundee, impts. in sewing machines.

1332. William Spence, of Quality-court, impts. in the mode of rifling muzzle-loading cannon and in projectiles for the same,—a communication.

1333. Henry James Burt, of Balsall-heath, impd. chaplet or head-dress.

1334. William Clark, of Chancery-lane, impts. in gas burners and chimneys, —a communication.
1335. William Clark, of Chancery-lane, impts. in machinery for the manufacture of hinges,—a communication.
1336. George Henry Ogston, of Mincing-lane, impts. in the manufacture and reburning or revivification of animal charcoal.
1337. Frederick Ransome, of Queen-street-p'ace, Southwark-bridge, impts. in the manufacture of slabs, bearers, and other articles of artificial stone where great strength is required.
1338. Richard Langridge, of Bristol, impts. in the means or method of securing or fastening the stiffeners or supports of stays, corsets, and other such like articles of dress.
1339. John Frederick Cooke, of Cannon-street, City, impts. in the manufacture of pocket pencils.

The above bear date May 13th.

New Patents Sealed.

1864.

2869. R. G. Grimes.
2956. John Evans.
2959. L. A. W. Lund.
2962. W. E. Carrett, J. Warrington, and and J. Sturgeon.
2971. A. J. L. Gordon.
2972. George Axton.
2977. J. D. de Boulimbert.
2981. R. F. Dale.
2982. E. W. Otway.
2985. Henry Caunter.
2987. F. B. Doering.
2989. Abraham Hawkes.
2994. F. A. Wilson.
2997. Julius Sax.
2999. Joseph Neat.
3003. M. J. Roberts.
3004. S. P Kittle.
3007. G. Wailes and B. Cooper.
3008. William Pollock.
3009. E. A. Cowper.
3011. John France.
3012. J. K. Crawford.
3016. J. W. Proffitt.
3018. C. W. Siemens.
3020. J. G. Winter.
3022. Richard Tye.
3027. J. Yearsley and E. Timbrell.
3032. Alexandre Blampoil.
3034. W. E. Gedge.
3036. George Dixon.
3038. Thomas Archer, Jun.
3039. John Keeling.
3045. E. T. Hughes.
3046. Richard Richardson.
3048. C. A. Martius.
3051. Alfred Albért.
3052. W. Husband and J. Quick.
3053. M. J. Roberts.
3055. J. Livesey and J. Edwards.
3057. Charles Oliver.
3058. John Norton.
3060. Charles Crockford.
3062. R. A. Brooman.
3065. William Tongue.
3066. T. H. Roberts.
3069. A. J. Sedley.
3070. Lazarus Morgenthau.
3071. John Vaughan.
3072. George Rooper.
3075. Edward Brooke.
3078. Robert Mathers.
3080. F. G. Mulholland.
3082. R. H. Johnson.
3083. Charles Kendall.
3095. J. B. Thompson.
3099. G. W. Belding and D. E. Holman.
3100. J. G. Tongue.
3101. P. F. Lunde.
3103. C. P. Coles.
3104. Samuel Hood.
3105. James and John Leeming, and John Lister.
3107. A. F. J. Claudet.
3108. John Anthony Pols.
3114. W. E. Gedge.
3118. R. A. Brooman.
3119. F. A. Chevallier.
3120. George Brown.
3121. James White.
3122. William McNaught.
3123. William Cotton.
3125. M. J. Haines.
3126. J. L. Norton and W. Ainsworth.
3133. William Brookes.
3134. R. A. Brooman.
3136. H. L. Hall.
3137. Zebina Eastman.
3142. William Tate.
3145. C. W. Orford.
3147. H. F. McKillop.
3150. J. Butchart, H. Stroud, and S. A. Morrison.
3151. E. T. Hughes.
3152. H. J. H. King, H. E. Smith, and J. B. Howell.

3155. H. Drunnear and P. Laidet.
3158. George Leach.
3159. T. A. Grimston.
3163. José Ping y Llagostera.
3164. H. A. de Brion.
3166. Joseph Westwood, jun.
3168. C. G. Hill.
3169. Michael Henry.
3170. Frederick Tolhausen.
3171. J. Ramsbottom and F. Blackburn.
3175. J. H. Johnson.
3176. James Hargreaves.
3178. Henry Edmonds.
3180. J. G. Aram.
3181. C. G. Wilson.
3182. James Byrne.
3188. George Haseltine.
3190. W. E. Gedge.
3191. James Paterson.
3192. John Bethell.
3197. Edward Saunders.
3202. Edmund Leahy.
3204. John Rowberry.
3210. Thomas Whitley.
3213. John Wolstenholme.
3219. James Dodge.
3220. Henry Johnson.
3227. W. H. Preece and A. Bedborough.
3229. J. D. Morrison.
3230. George Edwards.
3243. Enoch Shufflebotham.
3250. Thomas Bouch.
3252. L. P. E. Max.
3254. W. E. Newton.

1865.

1. William Muir.
2. T. A. Macaulay.
5. J. F. Parker and J. Tanner.
11. Martin Benson.
21. J. Knowles and J. Banks.
36. A. V. Newton.
37. J. C. Amos and W. Anderson.
39. A. G. Lock.
44. B. Dobson, W. Slater, and R. Halliwell.
52. Edward Tyer.
57. E. Beanes and C. W. Finzel.
65. John Welsh.
66. Lionel Weber.
77. Humphrey Chamberlain.
82. J. F. Spencer.
89. John Ramsbottom.
95. Rock Chidley.
96. J. G. Jones.
107. J. B. Hill.
127. James Young.
142. S. J. Best and J. J. Holden.
162. Edward Williams.
164. Robert Mallett.
165. J. A. Shipton and R. Mitchell.
173. John Hewes.
178. J. Snell and W. Renton.
180. William Clay.
197. J. B. Wood.
205. R. R. Riches and C. J. Watts.
210. Thomas Steel.
222. J. H. Pepper and T. W. Tobin.
228. J. Hamilton, jun.
248. B. Dobson and W. Slater.
272. T. Hall and S. Bonser.
291. Andrew Murrray.
306. J. R. Webb.
309. S. W. Wood.
332. Charles Beard.
333. W. P. Wilkins.
361. William Staats.
375. John Ramsbottom.
412. W. B. Newbery.
443. E. B. Wilson.
468. J. G. Jones.
473. J. G. N. Alleyne.
476. Andrew Sharp.
481. Robert Wilson.
488. C. V. Walker and A. O. Walker.
491. Isaac Pariente.
538. Peter Armand le Comte de Fontainemoreau.
540. E. H. Eldredge.
549. William Sim.
556. S. S. Gray.
564. John Fordred.
574. C. J. Falkman.
588. W. S. Thompson.
596. W. R. Bowditch.
614. Joseph Whitley.
617. Abraham Ackroyd.
623. T. S. Sperry.
630. George Nimmo.
640. H. W. Wimshurst.
643. John Dean.
672. William Smith.
691. James Henderson.
725. Henry Owen.
734. S. B. Boulton.
749. G. Dibley and F. Braby.
753. A. V. Newton.
776. A. V. Newton.
786. J. H. Johnson.
794. H. S. Jacobs.
822. Joseph Tall.
856. John Todd.
861. C. J. L. Leffler.
903. W. Milner and D. R. Ratcliff.
936. J. H. Johnson.
981. J. H. Johnson.
1004. Alfred Homfray.
1051. A. V. Newton.
1128. John Emary.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S

London Journal of Arts and Sciences.

No. CXXVIII. (NEW SERIES), August 1st, 1865.

THE ATLANTIC TELEGRAPH CABLE.

If ever there was a subject which deserved the concentrated attention of the engineering world, it is the enterprise in which that monarch of the waters, the "Great Eastern," is now engaged. In the last attempt to connect the New and the Old Worlds electrically, although the finest ships then available to the Governments of England and the United States were pressed into the service, they were found barely equal to their work. The result of the undertaking is well known: the cable, that was destined to bind two great nations indissolubly together, was submerged, and showed for a while feeble evidences of vitality; but a collapse quickly ensued. Since this costly experiment, the public has taken some seven years to recover from its disappointment; but now, another, and, we trust, more successful, attempt has been rendered possible, with the promise of Government assistance, by the formation of a company, under the title of the "Telegraph Construction and Maintenance Company (Limited)," to connect the shores of Ireland and Newfoundland by an electric cable; and hence, the expedition, the result of which, we doubt not, our readers are anxiously awaiting. The operation will necessarily be slower than when the "Agamemnon" and the "Niagara" commenced, in July, 1858, to pay out simultaneously their respective portions of the cable in mid-ocean, and thus divided the labour between them; but the risks or chances of failure will, we think, be much less in the present instance, for not only do the engineers, to whom the laying of the cable is entrusted, possess a knowledge of the accumulated experiences of seven additional years, which have seen both the failures and successes of many great undertakings of a similar character, but the enterprise is in the hands of one undivided staff. Moreover, the monstrous bulk of the "Great Eastern"—which carries the whole of the main line, rendering her, as it must do, less sensitive than smaller vessels to the pitching action of the waves—may well be supposed to ensure a more equable delivery of the cable than heretofore. With respect to the cable itself, if we are to believe newspaper reports, there never was such a piece of insulation turned out; but, however that may be, it is certain that its design has

been well considered, and it now embraces, we believe, some important suggestions of Dr. Fairbairn. The manufacture was carried out at the works of Messrs. Glass and Elliott, of Greenwich, assisted by Mr. Henley, of North Woolwich, and the engineering is, we believe, entirely in the hands of the manufacturing company whom Mr. Glass represents.

Having had an opportunity of inspecting the "Great Eastern" just before she sailed, and also the ship "Caroline," which carried the shore end of the cable, we may, perhaps, be able to give an idea of the arrangements that have been adopted for packing the cable, and for facilitating the delicate operation of paying out. This has, heretofore, proved a very difficult, not to say dangerous, operation, by reason of the tendency, which the cable possesses, of running into "kinks" when uncoiling—that is, of taking a permanent twist, which dislocates the internal arrangement of the cable,—forcing the copper wire, which forms the core, into contact with the metallic coating that is laid around the insulating material, to give strength and durability to the cable. Whenever this accident occurs, the paying out has to be stopped, and the kink cut out; the ends of the copper wire are then carefully spliced, to restore the electrical condition of the cable, and proper precautions are taken to strengthen the junction. To form kinks, it will be understood, is therefore a serious matter, and too much care cannot be taken to avoid them. At an early period of submarine telegraphy, Mr. R. S. Newall, of Gateshead, being practically acquainted with the risks attendant on the paying-out of telegraph cables from the hold of a ship, hit upon a very simple way of facilitating their delivery, and in May, 1855, he patented his plan. It consists simply in building up a cylinder in the hold intended to receive the coil of cable, and fixing a cone in the centre of the cylinder. This cone forms a core for the cable, which is carefully coiled around it in horizontal layers, beginning from the outside next the cylinder, and coiling towards the cone. When the cable reaches the cone, the "bight" of the cable is taken back to the outside of the coil, and a fresh layer is commenced. The cylinder and cone form a secure packing for the coil of cable, which, if once displaced by the tossing of a rough sea, would have to be taken to port, unshipped, and recoiled, before the paying out could be commenced.

Now, in the "Caroline," the cable, which was made very strong, to resist the abrasion of the rocks,* was laid in the form of a long oblong

* According to the *Times* Special Correspondent, this cable is, 5 miles out, 2½ inches in diameter; at 10 miles distance, 2 inches; at 15 miles it is reduced to 1½ inch; at 20 miles to about 1 inch; and at 25 miles of its extreme length it merges into the ordinary size of the deep sea wire with which it has to be jointed.

coil, supported on the outside by strong uprights, and secured at the eye or middle of the coil by a strong timber framing, so contrived as to offer no points of obstruction to the delivery of the cable as it is drawn up out of the hold. In the "Great Eastern," however, a somewhat different arrangement has been adopted. Instead of the strong uprights which supported the exterior of the coil in the "Caroline," the great ship has been fitted with three enormous water-tight iron tanks, into which the cable has been coiled, after Mr. Newall's manner. These tanks, we believe, originated in a suggestion of Mr. Siemans, C.E., who was engaged by Government to certify to the efficiency of the construction and mode of packing a cable originally designed for the East Indies, but afterwards known as the Malta and Alexandria cable. In consequence of the rapid heating of the coils, Mr. Siemans required that they should be kept immersed in water during the voyage, and the success of this plan had induced its adoption in the present instance. The cable appears to have been coiled into the three tanks around a temporary core, which was then removed to give place to a telescopic arrangement of skeleton framework, designed by Messrs. Canning and Clifford, the engineers engaged in the important work of paying out the cable. These telescopic frames fill the eye of the coil, and prevent any portion of the cable falling into the eye of the coil and getting entangled during the paying out. Windlass barrels are placed at the bottom of the framework, and leading down to them through guide pulleys are wire ropes attached to the several sliding or telescopic frames, apparently with the view of drawing down these frames one within the other, as the depth of the coil decreases, "thus forming," as it has been described, "a sinking core around which the ascending cable might run."

This was precisely the arrangement which a jury determined, in the case of Newall *v.* Elliott, in February, 1864, was an infringement of Mr. Newall's patent, but which, from being applied at sea, beyond the jurisdiction of his patent, was ultimately declared to be no invasion of the inventor's rights. Without going so far as to say that this adaptation of Mr. Newall's principle will not answer so well as the fixed cone, we may confidently affirm that it is in no respect better. On the contrary, it involves more trouble and expense in coiling and packing the cable, and being but at best a skeleton core, it renders it possible for a loose piece of timber falling within the eye to obstruct the ascending line of cable, and produce a "fault" of some kind that will necessitate the stoppage of the operation of paying-out to make good the injury. That some such accident has occurred we have every reason to believe, for the telegram received from Valentia, dated July 25th, states "there has been a hitch, but all is now rectified;" and

again, on the same day, a more explicit statement was given, viz., that "a small fault has been discovered and cut out." Fortunately, the weather was propitious for laying-too while the splice was being made, for we are further informed with respect to the "Great Eastern" and her cable, that "she is now paying-out again, and the signalling is perfect."

In a national undertaking like the laying of the Atlantic telegraph cable, it was highly important that every precaution should have been taken to secure success, even though the managing director of the company had been reduced to the mortifying position of acknowledging merit in the invention of a rival manufacturer. Had a reasonable proposition been made by the company for the use of Mr. Newall's apparatus, we have no doubt it would have been heartily received; or if the determination had been adopted to brave the consequences of a law-suit, and avowedly to invade the patent, the public would have had nothing to say to that course; but to jeopardise, to ever so small an extent, a national undertaking, by omitting to use the best known form of apparatus for laying down the submarine telegraph cable, for fear of consequences independent of the enterprise in hand, is altogether indefensible.

Besides the outer cylinder and cone which Mr. Newall employs to form an annular space for the reception of the coil, he uses suspended rings for guiding the cable upwards out of the hold to the brake apparatus, which delivers the cable over the stern of the ship into the sea. No guides of this kind were fixed in either vessel at the time of our visit, but since she sailed the "Great Eastern" has evidently been provided with a contrivance of that kind, for the *Times*' correspondent, in his communication, dated July 24th, says:—"The circular guards, called crinolines, to be suspended over the cable tanks, and through the centre of which the cable will be paid out, have been fixed." If, therefore, the laying of the cable should prove no mere evanescent success, Mr. Newall must share in the credit which will rightly belong to those whose united exertions shall have resulted in "a consummation devoutly to be wished."

Since the above was in type, a telegram, dated Valentia, July 26th, says:—"The 'Great Eastern' picked up eleven miles to the fault in the cable, which was caused by a piece of wire being driven quite accidentally into the core by the paying-out machinery." If this be the true explanation of the "fault," it is a strange result of the excessive show of caution displayed on board to protect the cable from injury through wilful or thoughtless acts.

NOVEL PRACTICE IN PATENT LAW ADMINISTRATION.

A curious case, arising out of an application made to the Solicitor-General for a disclaimer upon a patent that had been declared invalid by reason of the defective nature of the specification, has recently been under discussion, and deserves the serious attention, not merely of patent lawyers, but of all persons interested in patent property. It will be remembered by our readers that in January last the Lord Chancellor gave judgment on the case Simpson *v.* Holliday, which was an appeal from a decision of Vice-Chancellor Wood, delivered in June, 1854, condemning the defendant in costs for an infringement of Medlock's patent for preparing aniline dyes by treating aniline with dry arsenic acid, which patent had become the property of the plaintiff Simpson and his partners. The Vice-Chancellor had pronounced in favour of the validity of the patent, but this point the Lord-Chancellor over-ruled, on the ground, to state it briefly, that two alternative processes of preparing the dye had been described, and that confessedly but one would answer.* Two courses now lay open to the plaintiff, either to appeal to the House of Lords or to amend the specification by disclaimer, and to commence proceedings *de novo* against Mr. Holliday. The latter was the course determined on, and, in pursuance of this decision, a disclaimer was prepared, striking out the objectionable matter, and leaving only the description of the process which was in profitable use. Advertisements required by the statute were published, stating the intention of the plaintiff to disclaim, and inviting the opposition of all parties interested in stopping the grant of the disclaimer. As the process was very valuable, an unusual number of chemical manufacturers signified their intention of opposing the application, and in due course a day was appointed for hearing the objections to the disclaimer.

It would appear that at the hearing of the case, which came off before the Solicitor-General, on the 28th of March last and on subsequent days, the petitioners for the disclaimer were represented by counsel, who urged the conformity of the form of disclaimer with the provisions of the statute, in respect of which, as we understand, no exception was or could reasonably be taken. The parties who had lodged notices of opposition also appeared at the hearing; but no evidence of any kind was given or tendered by them. This would seem to show that some sufficient objection had been raised to the disclaimer by the Solicitor-General, which rendered it unnecessary for the opponents to state their objections. After mature deliberation, and, no doubt, as the practice of the Solicitor-General in cases of the kind would lead us to infer,

* For reports of this case see Vol. XX., p. 105, and Vol. XXI., p. 111, of this JOURNAL.

with the concurrence of the Attorney-General, the following decision was delivered, in writing, to the agent of the petitioners:—

THE SOLICITOR-GENERAL'S JUDGMENT.

I hereby grant my fiat, giving leave to the above-named George Simpson, George Maule, and Edward Chambers Nicholson (the assignees and now legal and equitable owners of the said letters patent), to file, in the Great Seal Patent Office, with the specification to which the same relates, the above written disclaimer, subject to the condition written below, and to the payment of the costs attending the opposition before me.

R. P. COLLIER, Solicitor-General.

Temple, May 18th, 1865.

THE CONDITION ABOVE REFERRED TO.

No action is to be hereafter brought against Thomas Holliday and Company, of the Turnbridge Colour Works, Huddersfield; Roberts Dale and Company, of the Cornbrook Chemical Works, Manchester; Wilson and Company, of the Chemical and Colour Works, Jubilee-street, Mile-end, E.; Dan Dawson, of Huddersfield; Hugo Levinstein, of 5, New Bridge-street, Blackfriars-road; Read Holliday, of Huddersfield; Richard Smith, of West-street, Glasgow, manufacturing chemist; or any or either of them, for any infringement of the said patent, by the use or continued use, during the continuance of the said patent, of any process or processes for manufacturing or preparing red and purple dyes which is or are in use by them, or either of them, at the present time.

R. P. COLLIER.

The nature of the condition appended to the allowance of the disclaimer very naturally astonished the owners of the aniline patent, and led them, under the advice of counsel, to reject the grant of the Solicitor-General's fiat, and he consequently filed a disallowance of the disclaimer. An appeal was then made to the Patent Commissioners in the form of a petition, setting out the facts of the case, and ending with the following prayer:—

"1. That the Solicitor-General having granted his fiat for the disclaimer, your Petitioners submit that such fiat cannot be recalled; and they pray that you will be pleased to file the said disclaimer with the fiat, so that your petitioners, not having consented to the conditions, may be enabled to try the question of their validity;

"2. *Or that* the said disclaimer may be referred to one of the law officers mentioned in the statute, with such instruction as to you, the Commissioners of Patents, may seem fit;

"3. *Or that* the Commissioners of Patents require a fuller statement of the case, that your Petitioners may be heard by counsel before the Commisioners of Patents;

"4. That the Commissioners of Patents will give to your Petitioners such further or other relief as they may see fit."

As, however, it is not usual for the Lord Chancellor to disturb the ruling of the law officers—two of his fellow Commissioners—and as the Master of the Rolls would hardly think it right to go counter to the head of the legal profession, the petition met with no success, but was returned by the present Lord Chancellor, endorsed with the word "refused."

Messrs. Simpson and Co. are thus left without any resource short of legislative interference for amending their specification; the consequence of which is, that a valuable property has been sacrificed as completely as if the Disclaimer Act of 1835—that valuable contribution made by Lord Brougham to our laws—had never existed. If this practice is to be continued, it will be useless in future for the owner of a defective patent to take comfort to himself that, in the words of the Act, he "may, if he think fit, enter with the Clerk of the Patents * * a disclaimer of any part of either the title of the invention or of the specification:" for he has first to obtain the leave of the Attorney or Solicitor-General, who, not content with exercising a limited discretion like their predecessors, and ascertaining that no proposed disclaimer "shall extend the exclusive right granted by the said letters patent," may think fit to impose such conditions as will, in effect, confer a free license on all who have had the baseness to infringe upon the applicant's patent.

That the law officers ever contemplated such a result from the decision given above we should be the last to assert, for more conscientious, painstaking administrators of the law than our present law officers could not well be found; but that the principle acted upon with respect to Messrs. Simpson's disclaimer will have a most oppressive and demoralising tendency, if followed up, we are quite certain, and for this reason, and for this only, we enter our protest against it.

Recent Patents.

To JAMES ALLAN, *of Dundee, N.B., for an improved adhesive mixture.*—[Dated 22nd August, 1864.]

THIS invention relates to a mixture for the purpose of fixing leather, gutta-percha, india-rubber, or any other like material on the surface of cast iron, wrought iron, brass, or any other metal, and consists of a combination of common glue, ammoniacum, and nitric acid, or any other

gum or acid of similar power and strength. The two first-named ingredients are placed in a suitable vessel, and properly dissolved by fire or steam heat, and when commingled by a hand stirrer, or by suitable machinery, the third ingredient is added. This mixture is chiefly intended to be used for the purpose of fixing leather on the outer surfaces of the rollers used in the preparing machinery of jute, wool, flax, cotton, and other similar materials.

The chief advantage resulting from this invention is, that a mixture is obtained, the adhesive principle of which is of a much superior quality to any hitherto employed, and that although the metals be covered with oil, that does not affect its adhesive powers. The mixture may either be in the liquid or solid state, and it can be applied with a brush, or in any way that common glue is applied. The proportions of such ingredients which it is preferred to employ, are 112 lbs. of common glue, and 7 lbs. of nitric acid to 7 lbs. of ammoniacum, although other proportions may, in many instances, be advantageously employed.

The patentee claims, "the combination of substances for producing a new adhesive mixture for the purposes described."

To ALFRED FORD, *of Peckham, for an improved method of manufacturing floorcloth.*—[Dated 24th August, 1864.]

THE patentee coats with a solution of size a textile fabric, so as to form what is known to india-rubber workers as a "stripping cloth." He then applies to the sized surface of this cloth, by means of rollers or some other suitable machine, a coating of india-rubber, or of india-rubber in combination with some earthy, mineral, or vegetable substance, and softened or not by solvent, as occasion may require, and of sufficient thickness to admit of its being subsequently stripped off the cloth without injury. To the cloth so coated, he applies, by means of rollers or a spreading machine, a mixture composed of bruised or ground cork, and a solution of india-rubber, or of some other glutinous or adhesive material, capable of holding the particles of cork together; and thus forms what is known as a kamptulicon surface. He then dries the fabric by heat, and subjects it to repeated pressure through rollers, so as to give it the necessary thickness and consistence. The whole is then stripped from off the "stripping cloth," and a cork floorcloth is formed, with an elastic india-rubber back.

The cloth so formed may be perforated with eyelet holes, filled with eyelets, and so arranged as to form a pattern on the surface of the cloth. The object of this proceeding is to admit of the ingress of air between the cloth and the flooring, so as to prevent the latter becoming rotten by the damp.

The patentee claims, "First,—the production of a floorcloth having a cork surface with an india-rubber back; and, Second,—the production of a floorcloth, so perforated as to admit of the ingress and egress of air between it and the flooring to which it is applied."

To THOMAS BRIDGES HEATHORN, *of St. James's-square, for improvements in the construction of submarine and other foundations.*—[Dated 26th July, 1864.]

THIS invention relates to the construction of submarine foundations where there is a level, shelving, or sloping bottom of a varying density, possibly covered with mud, sand, or shingle to a great depth.

In Plate III., fig. 1 shows in section a portion of a floating caisson of an annular construction, the polygonal outline varying according to the formation of the superstructure; fig. 2 is a section of a caisson fixed and ready to receive its superstructure; fig. 3 is an elevation of a fort with this substructure, and erected in deep water upon a hard shelving bottom; figs. 4 and 5 are sections of this superstructure for a muddy bottom, with no rock or hard bottom underneath; and fig. 6 is an elevation of a caisson which may be used for a shelving or sloping bottom, in place of that shown by figs. 2 and 3.

The mode of fixing these superstructures is as follows:—The portion of caisson, shown by fig. 1 is floated out to sea, exactly over the spot upon which the building is to be erected, and there anchored. Concrete is then placed in the caisson so as to cause it to sink evenly, and as soon as this portion of the caisson is sufficiently deep in the water, an additional height is added, and concrete placed therein to sink it deeper in the water; this operation continues until a firm foundation is obtained by the weight of the caisson, with interior filling of concrete, sinking through the mud or other soft ground to the hard ground beneath. The interior is then filled up with stones or concrete, or stones and concrete, upon which and the concrete the superstructure is erected. Should the hard ground be of a shelving or sloping bottom, the caisson will only bear upon the highest side of the same, and to preserve its perpendicularity, immediately it touches the hard ground, stones are discharged through the interior of the caisson, and will naturally settle in such a position as to form a foundation upon which the caisson may rest, as shown by figs. 2 and 3. The caisson may, however, be made to bear equally upon the shelving or sloping bottom, and still retain its perpendicularity, as shown by fig. 6. On a muddy bottom, with no rock or hard substance underneath, a caisson, similar to figs. 4 or 5, should be used, which would, on being sunk as before described, force the mud or sand up into the conical space until it arrived at the apex, when the soft soil would be compressed and densified in the cone, and a firm, unyielding foundation is obtained.

This mode of obtaining foundations in water with a muddy bottom, with no rock or hard substance underneath, will also apply to obtaining the same in soft or peaty ground on land, with only a difference in the plan of construction, viz., the caisson being built up in a trench of a certain depth, which would be regulated according to the density of the soil; the mode of sinking it being the same as before mentioned.

The patentee claims, "the construction of submarine and other foundations, substantially in the manner hereinbefore described."

To PERCY GRAHAM BUCHANAN WESTMACOTT, *of Elswick, Newcastle-on-Tyne, for improvements in hydraulic cranes.*—[Dated 3rd August, 1864.]

HERETOFORE, in hydraulic cranes, the cylinder or cylinders of the hydraulic machinery have been separated from the crane itself, and carried upon an independent foundation or bed plate. Now, according to this invention, the cranes are constructed in such manner that the hydraulic machinery is carried within the parts of the crane itself. For this purpose the cylinder and ram are placed upon the pillar or jib of the crane, and the water supply pipe of the engine is conveyed up through the pivot upon which the crane pillar turns. The water supply pipe, which rises up through the pivot upon which the crane pillar turns, as before mentioned, either passes to the cylinder, or, if the valve be also attached to the crane, it passes to the valve, and so to the cylinder. It is preferred that the pipe should pass through the lower pivot, as by so doing advantage can be taken of the pressure of water, acting on the area of the supply pipe passing through the pivot, to ease or relieve to that extent the weight of the parts revolving upon the bottom socket, and thus enable the jib to be turned with greater ease.

The figure in Plate IV. shows a side elevation of a crane, constructed and worked according to this invention. A, A, is the pillar, composed of parallel plates; B, is the jib; C, C, are the stays; D, D, is the bottom pivot, on which the pillar turns; E, is the top pivot; F, is the top socket; G, is the bottom socket; H, is the hydraulic cylinder, carrying the pulley O, and the cylinder has also one end of the chain P, attached to it; I, is the ram, which carries the pulley O^1, over which the chain P, passes, then under the pulley O, thence over the pulley O^2, and then over the pulley O^3, at the upper end of the jib. The length of the hydraulic cylinder and ram, and the number of the multiplying pulleys, will depend on the length of lift required. K, K, are the guides for the ram; L, is the valve, having a handle for working the ram; M, M, are the pressure pipes; and N, N, are the exhaust pipes. It is preferred that the pivot, which works in the bottom socket, should be made with a vessel or cistern to receive the exhaust water from the cylinder, as also the drainage water, before passing through the bottom socket to the exhaust pipe or drain; and it is also preferred that the water for working the hydraulic cylinder should pass through the bottom pivot, but, if desired, it may pass through the upper pivot, or be otherwise separately supplied to the hydraulic cylinder.

The patentee claims, "constructing the hydraulic cylinders and valves of hydraulic cranes with, in place of separate from, the cranes."

To JAMES RADCLIFFE, *of Hollinwood, and* MAJOR RADCLIFFE, *of Manchester, for certain improvements in the manufacture of narrow fabrics, such as "tapes," "webbings," "bands," "ribbons," or other similar articles.*—[Dated 4th August, 1864.]

THIS invention consists in the employment of one shuttle only in the manufacture of narrow fabrics. The weaving is effected in the ordinary manner, the warp and weft being employed as in weaving calico

or other fabric (or, if preferred, the warp may extend from back to front, as usual, and the weft be thrown across diagonally to the warp); but, instead of weaving an entire fabric across the loom, the selvage is formed by well-known means, in many places, across the width, thus dividing the fabric into a series of bands joined together by the combination of the weft threads. In this state the piece may be bleached, dyed, and embossed with a rib or pattern, or not, or they may be otherwise treated as piece goods, and when finished, by severing the weft threads close to the selvages, a number of finished "ribbons," "tapes," or bands will be produced the entire length of the piece, and in a finished state.

In Plate III. fig. 1 represents in plan a portion of a loom for weaving the tapes or ribbons, and showing more particularly the subdivision of the warp threads, and also the position of the selvage and ordinary heald shafts.

Fig. 2 is a diagram of the healds, showing the arrangement of the extra or supplementary heald shafts, and the method of connecting the same at the top and bottom, with the front or selvage healds. This diagram shows also the respective position of such healds in connection with the ordinary healds at the time of twisting or forming the selvages of each respective tape or ribbon.

In fig. 1, a, a, is the framing of the loom, and b, b^1, the tappets actuating through the "jacks," the extra or supplementary shafts of the front or selvage healds c, c^1. These heald threads (shown in dots) are placed so as to act upon the outside warp threads of each respective tape, in the manner hereinafter described, the subdivision of the warp threads into tapes (shown by thick dots) being more readily seen in fig. 1. In fig. 2, the selvage healds c, c^1, and the ordinary healds d, d^1, are shown with the shed open, and in the position when forming the selvages of the tapes, the action of which will be understood on reference to the diagram. The warp threads passing through the first loop c^2, of the extra or supplementary healds, is continued thence to the first eyelet or loop d^2, of the ordinary healds d; the bottom or lower warp threads forming the "shed" is passed in like manner through the loop e, of the back or selvage heald c^1; from thence it passes through the eyelet e^1, of the ordinary back heald d^1, thereby causing, as the "shed" closes, a twist or knot to be given to the outside warp threads of each tape with the weft as it is delivered from the shuttles during its traverse across the "shed."

The patentees claim, "weaving narrow fabrics, such as tapes, bands, webbings, or ribbons, with one shuttle only, by subdividing the warp into narrow widths, and forming a selvage at each side of each width or tape by the action of the healds; such narrow fabrics having hitherto been woven by a number of shuttles each traversing only the width of one tape, so as to form the selvages, as described."

To FRANCIS THORNTON, *of Grosvenor-street, Camberwell, for improvements in presses for pressing and packing cotton, wool, silk, hay, straw, and similar substances.*—[Dated 4th August, 1864.]

IN Plate III., fig. 1 shows a side elevation, partly in section, of a pair of presses, constructed and worked according to this invention; and

figs. 2 show some of the details separately. The pair of presses are arranged in such manner that their pistons are both attached to one piston rod, and at the respective ends thereof, so that as the piston of one is moved to compress the cotton or other fibrous substance into a bale, the piston of the other is moved back, so as to leave the trunk or box vacant to receive a charge; consequently, a bale is made alternately in each of the two presses. At the outer end of each box is a separate frame, the skeleton or framing of which is of strength to receive and have compressed within it the charge which is introduced into the box, and when the bale has been thus compressed into such frame, the frame with the bale is detached from the end of the box, and from the piston, whilst the side of the bale, against which the piston has previously pressed, is retained under pressure by means of bars or other arrangements previously received into recesses in the face of the piston; such bars or instruments being locked to the frame of the receiving chamber within the frame at the end of the box.

A, and B, are the boxes of the two presses, and A^1 and B^1, are the two frames which are applied at the respective outer ends of the two boxes. The frames A^1, B^1, are lined on the interior, and formed with doors to remove the bale after it has been properly lashed or bound, and it may be stated that the lashing or binding of a bale is similar to that now in ordinary use. C, is the piston rod, to the two ends of which the pistons working in the two boxes A and B, are fixed. The piston rod is formed into a screw, in order that it may be moved to and fro by means of a screw nut D, which works in bearings on two fixed blocks E, E; and the screw nut is in the centre of the nave or boss of a screw wheel F, which is worked by a worm shaft G, driven by a steam-engine, arranged intermediate of the two boxes of the pair of presses. When either of the piston rods is in the position of the one shown in the box A, the door at the upper part of the box is opened, and a charge of cotton is introduced; the door is then shut and fastened, and the outward movement of the piston then takes place by which the cotton is driven into and compressed in the frame at the outer end of the box, which, for the time, is secured to the outer end of the box, by means of the projecting ends of the bars at the four angles of such frame, entering suitable sockets or recesses H, H, formed in the framing at the ends of the boxes; and the four ends of the bars of the detachable frame are secured into position by bolts I, I; or the parts of the frames A^1, B^1, which enter and connect with the frames of the boxes A and B, may be otherwise attached and securely held for a time, so as to form as it were, in each case, part of the box of the press. When the piston of a press has completed its outward motion, it is withdrawn a short distance, when the door K, is opened, and bars are introduced along grooves L, formed in the face of the piston, the piston is then caused to move outwards and push the bars over lugs on the frame A^1, or B^1. The rods or bars are retained in position by means of keys M, or the bars or instruments used for retaining the bales in the frames A^1, B^1, may be otherwise arranged to be locked into the frames by spring or other latches or stops applied to the frames, and as soon as the fastening of the bale within a frame A^1, or B^1, has been accomplished, that frame, with the bale therein, may be detached by withdrawing the bolts I, or other fastenings employed; and the

parts of the frames A^1 and B^1, may then be detached from the ends of the box or trunk, by causing the piston to be moved outwards a distance requisite for that purpose; or the frames A^1, B^1, may be removed in other suitable manner.

Fig. 1 shows the two presses combined together, with a steam-engine for working them, forming one carriage mounted on four railway wheels; but wheels, suitable for running on other roads, may be used in place thereof. The frames A^1, B^1, are also each mounted on four wheels.

The bale having been thus produced in a frame A^1, B^1, is, after it has been bound or lashed, delivered by the opening of the doors.

The patentee claims, "the mode herein described of combining and working two presses."

To NEIL MCHAFFIE, *of Glasgow, for improvements in treating iron plates for ship building, boiler making, and similar uses, and also wrought iron in other forms, to render it capable of resisting oxidation or destruction by sea and other water, and atmospheric and other corroding influences.*—[Dated 6th August, 1864.]

THIS invention consists in treating wrought iron, whether it be in the form of plates or sheets, or forged or fashioned to any desired shape, for sheathing ships, by surrounding it with oxide of iron, or oxide iron ore, or with oxide of manganese, or oxide of zinc, or matters containing these or similar metallic oxides or substances, and the whole is heated by preference to a full red heat; it is maintained at this temperature for many hours, and afterwards is gradually cooled. The wrought-iron plates, sheets, forgings, or other pieces, will by this treatment be found to have undergone a peculiar change, which enables them to resist more or less completely destructive or corrosive influences. The plates or other articles to be treated may be placed in troughs or pans of cast iron, or troughs built of fire bricks; if of fire brick, suitably protected from fire or air by plastering with fire clay or wet sand—that is, the brick troughs, or troughs of other material, placed or built inside of an oven, kiln, or furnace, such as used for cementing bar-iron for converting into steel, or such as used for annealing iron castings or hard hæmatite iron castings for making malleable iron castings: the form of the furnace and apparatus used is not material, so long as it is air-tight, and capable of being raised to and maintained at a red heat when containing the plates or other forms of wrought iron, together with the oxide or oxides. Alternate layers of oxides of iron or other oxides above named, with the sheets or plates or other articles of wrought iron to be treated, being placed in the troughs, and, by preference, troughs of iron, and closed air-tight, are placed in a furnace or oven, and are raised to and maintained at a red heat, and then allowed to cool slowly, excepting when the iron is desired to be hard, in such cases the cooling is to be quickened according to the effect it is desired to obtain. The length of time the red heat is to be maintained will depend on the intended uses of the sheets or plates or other forms of wrought iron, and also on the quality of the oxides, but a workman, after some experience, will readily judge. With thick iron

plates or sheets, such as armour plating, three days are sufficient, but from twelve hours to three days will generally suffice.

It is preferred to employ oxides of iron (such as hæmatite iron ore which has been once used in converting hæmatite cast iron into malleable cast iron), about one-fourth of fresh hæmatite ore being added thereto, but other oxides of iron or of other metal may be used in place thereof, or with such oxides of iron. The oxides thus employed are again and again used, about one-fourth of fresh oxide ore being each time added. The plates or other articles of iron may be placed, as above described, in the troughs, with layers of the oxide materials, when the furnace or oven is cold, and the whole brought up to a red heat; or the filled troughs may be drawn into a hot furnace or oven, and they may be withdrawn therefrom and cooled separate from the oven, more particularly when it is desired to quicken the cooling.

Wrought iron thus prepared, and without being painted or coated, on being immersed for a length of time in sea water, is found to be free from shell fish or marine animals, and also in a great degree free from corrosion or rust.

To MARK PAYNE, *of Thrapstone, Northamptonshire, for an improved construction of traction engine.*—[Dated 9th August, 1864.]

THIS invention relates to certain improvements in the details of construction of traction engines, the chief object being to maintain their working efficiency.

In Plate III. fig. 1 shows the improved engine in side elevation, or so much of it as is requisite to illustrate the nature of the invention; and fig. 2 is a partial transverse section of the same, showing the arrangement of the driving gear. A, A, is the boiler and framing of the engine, and B, is the axle of the driven or traction wheels; C, is the cylinder of the engine, inserted in the smoke box D, the crank shaft receiving motion from the piston rod of the cylinder. On the crank shaft is keyed a chain wheel *a*, which, through an endless chain *b*, communicates rotary motion to a chain wheel *c*, on the cross shaft E. This shaft E, is mounted in slotted brackets F, (see fig. 2,) firmly secured to the shell of the boiler. The driving power is transmitted to the traction wheels through a gear wheel G, of peculiar construction, mounted on the axle B. This wheel receives motion from a spur pinion *d*, attached to or cast with the chain wheel *c*, which is actuated, as before stated, by means of the endless chain and pinion on the crank shaft of the engine. This gear wheel G, is composed of two rings bolted to forked arms radiating from a central boss. These rings are also rivetted together by transverse rounds, into which the spur pinion *d*, gears as into spur teeth. The advantages of this arrangement are, that any dirt which may be taken up by the wheel G, cannot become imbedded between the teeth or rounds, but will work out by the action of the teeth of the pinion; also, that when by accident a round is broken, it can be readily replaced while the engine is on the road; and further, that the use of the rounds admits of the teeth of the driving pinions being increased in size and strength, and thus avoids the risk of their being stripped when the engine is engaged in heavy work. The

cross shaft E, carrying the driving pinion, is also fitted with a capstan H, which is intended to be used for hauling the engine out of any slough into which it may happen to run by the aid of a chain anchored ahead and connected with the capstan. When employing the capstan the driving pinion should be thrown out of gear with the wheel G. For this purpose the bearings of the shaft E, are made capable of being shifted in the brackets F, which carry them. This motion is effected by means of a hand lever I, connected by a rod I^1, to a double bell-crank lever *i*, keyed to a transverse rod i^1, running under the boiler. To this rod, near the opposite end thereof, is keyed a rock lever i^2, to the extremities of which, as also to the extremities of the bell-crank lever *i*, are jointed pendent wedges *k*, which slide in vertical slots made to receive them in the brackets F, and press alternately against the opposite end of the sliding bearings. As, therefore, the levers *i*, i^2, are rocked by the action of the hand lever I, the wedges on one side the fulcrum rod *i*, will rise, and on the other side be depressed, and thus the bearings will be slidden to or fro in the slotted brackets sufficiently to throw the pinion *d*, in or out of gear as desired. When the pinion is out of gear with the wheel G, motion may be transmitted to the hauling tackle or windlass used in steam cultivation. For this purpose, the hauling drum or windlass is mounted at the side of the engine, as shown at K, fig. 2, or it may be placed in any other convenient position, and the drum is cast with a ring of bevil teeth on its side. On the shaft E, is mounted a bevil pinion *e*, which gears into the bevil teeth on the drum K, and drives that drum when the spur pinion is thrown out of action. The cylinder or cylinders can be mounted either above or below the boiler, and within the smoke box. When the engine is intended to be used for general agricultural purposes, it is preferred to place the cylinder above the boiler; but in constructing engines exclusively for traction purposes, as steam ploughing and transporting loads, the cylinder may be placed as shown by dotted lines, as by that means the use of one shaft and of the endless chain are dispensed with. In this case the shaft E, will be the crank shaft, and as it will then be inconvenient to mount it in sliding bearings, it is proposed to use the ordinary sliding clutch for throwing the spur pinion *d*, in and out of gear. For the purpose of reducing friction, and to simplify the construction of the engine, the cross head is made to work on one fixed guide (instead of a pair, as heretofore), as shown in side view at fig. 1, and in cross section on an enlarged scale at fig. 3. In these figures, M, is the guide, and N, the cross head sliding thereon. This guide is carried by the prolonged flange of the stuffing box of the cylinder cover, and is further supported by a bracket on the shell of the boiler. The cross head N, is made in two parts, the lower part being a kind of inverted saddle piece, and embracing the brasses of the cross head, and the upper part which receives the coupling pin of the connecting rod fitting into the saddle piece, and being secured thereto by transverse screw bolts. This arrangement permits of access to the brasses of the fixed guide by simply removing the screw bolts which couple the parts of the cross head together.

The patentee claims, "First,—the application to traction engines of the gear wheel G, constructed and operating as above described. Secondly,—transmitting motion to a capstan and hauling drum from

the transverse driving shaft, as explained. And, lastly,—the arrangement of cross head and fixed guide, as above described."

To James Milbank, *of Chelmsford, Essex, for improvements in hot-water apparatus for heating conservatories and other buildings or apartments.*—[Dated 11th August, 1864.]

This invention relates to the arrangement of the boiler and fire-place, and parts connected therewith, whereby water is heated and caused to circulate in pipes or channels, for the purpose of heating conservatories and other buildings and apartments. For this purpose it is usual to employ what is termed a saddle boiler, which is of an arched form, both on the exterior and interior, the space between containing the water to be heated; the fire is placed in the interior, while the draught passes directly through.

In Plate III. fig. 1 shows, in vertical section, a boiler and stove, constructed according to this invention; fig. 2 is a sectional plan taken on line 1, 2, of fig. 1; and fig. 3 is a plan on the line 3, 4, of fig. 1. A, A, is the boiler, which is of an arched or saddle form on the top, and of similar form at the back, the fire B, being placed in the space so prescribed, as also by the front plate C; the plate C, encloses the front of the boiler and flues, which surround the entire exterior surface of the boiler, being limited and formed by the brickwork D. The boiler is thus subject to the heat of the fire throughout its entire interior surface, and to the heat of the flues on its entire exterior surface, or nearly so, and at the same time a small quantity of water being contained within the boiler, it readily becomes heated, and is caused to circulate in the pipes leading to the apartment or place required to be heated. E, E, are the fire-bars, resting on an angle iron or ledge formed on the lower part of the boiler; F, is the pipe by which the heated water leaves the boiler; and H, H, the pipes by which the water returns to the boiler. The flue space I, I, surrounding the boiler, is partially separated by a diaphragm K, K, at the upper part, separating it into two parts L, and M. The heat, flame, and products of combustion evolved in the fire-place B, finds escape only by a passage P, furnished with a damper G, at the top of the boiler near the front opening into the first flue space L. After circulating in the space I, and throughout one side of the boiler, it passes into flue space M, and circulates on the other side of the boiler, escaping thence by the flue R, to the chimney S; the heat is thus exposed to the whole, or nearly the whole, of the exterior surface of the boiler before it escapes to the chimney. T, is the ash-pit door by which the draught is regulated; U, is an opening for raking or stirring the fire; W, is the ash-pit; while X, X, are soot doors, for cleaning out the flues outside of the boiler.

According to this arrangement of boiler, the flame and gases of combustion, after heating the interior surface of the boiler, pass outside on the exterior surface, first on the one side and then on the other, and ultimately to the chimney. For feeding the fire, an inclined channel Y, is fixed to the front plate with a lid Z, by which the fire may be fed at pleasure; but when it is desired to provide a self-acting supply for a length of time, a lengthening piece Z^1, is added to the channel,

and filled full of the fuel to be used; this, as it is consumed at bottom, falls down the incline, and supplies the fire, and so continues the supply of the fire for a length of time. The heating is of course conducted in the ordinary manner, the hot water being conveyed away by the pipe F, and the cold returned by the pipes H, the heat being abstracted or given off midway between those points.

The patentee claims, "the arrangement and construction of boiler and furnace or heating apparatus for heating conservatories and other buildings or apartments hereinbefore described."

To JOHN ADAM *and* JOHN WEBB, *both of Laurence Pountney-hill, and* JOACHIM JOHN MONTEIRO, *of Harewood-square, for improvements in the application and in the preparation of certain fibres for the production of paper and textile fabrics.*—[Dated 11th August, 1864.]

THIS invention consists in employing the fibre obtained from the bark of the *Adansonia digitata* for the production of paper and for the manufacture of textile fabrics. The manner in which the fibre is prepared is the following:—Having previously removed the external covering or outer bark, and having obtained the inner bark, either by stripping or otherwise, it is either to be dried or desiccated previously to, or it may at once be passed through rollers or other machinery suitable for effecting its disintegration, so as to free it from sap, gum, and other matters. The crude fibre resulting from this process is then to be further purified by repeated washings with water, and, if requisite, may be further subjected to the action of an alkaline solution; and, after having been so subjected and subsequently washed with water, may, if necessary, be submitted to any of the well-known bleaching processes now generally adopted for the bleaching of cotton or other fibres, either by the employment of a solution of chloride of lime and an acid, or otherwise, as is well understood. When the fibre so obtained is to be employed for the manufacture of pulp or paper, it is employed either alone or in conjunction with other fibres or substances in the same manner as esparto or sparte and other fibres are now employed. When it is desired to prepare the fibres for the production of textile, woven, or other fabrics, the fibres, after having been separated from the vegetable and other matters with which they were originally associated by means of suitable rollers, beaters, scutching apparatus, or other suitable means, may, after having been submitted to a washing or cleansing process, be either directly employed alone or, by preference, with the admixture of other fibres, or they may be previously submitted to a bleaching process in the same manner as cotton and flax are now bleached, and as is well understood.

The patentees claim, "the employment of the fibrous portion of the inner bark of the *Adansonia digitata* after having been subjected to suitable treatment or preparation for the manufacture and production of paper, and also for the manufacture and production of textile or woven fabrics, in the manner herein described."

To William Richardson, *of Oldham, for improvements in rollers for cotton gins.*—[Dated 13th August, 1864.]

This invention relates to the rollers of gins on the MacCarthay principle, and which are usually covered with hide or leather, the object of the improvement being to attach the said covering in a more secure manner. For this purpose slits are formed of a spiral or other form in the hide or leather, but not through its entire thickness, and within these slits wire or strips of metal are bound, the ends thereof being fastened to the axis of the roller, or being otherwise made fast. The rollers are made of iron, wood, or other suitable material, and glue or other cement may be used between them and the hide or leather covering.

In Plate IV., fig. 1 represents, in longitudinal section, part of a roller constructed according to this invention; and fig. 2 is an exterior view of the same. In this case the roller is supposed to be constructed with an iron foundation *a*, provided with axles *b*; upon this the leather or other such covering *c*, is placed, either with or without glue or other cement. This covering may be made by combined strips wound on spirally in rings, or constructed and adapted in any usual manner. Each end of the said covering is then turned down, as at *d*, to a smaller diameter, and such turned-down parts are bound round with wire, to attach the ends to the iron foundation. The method adopted of fastening this wire is to drill a hole in the metal, and place one end of the wire therein, as at *e*; it is then wound around the leather, and the other end *f*, placed against the boss of the foundation *a*, after which a metal plate *g*, is screwed on to the boss, and the wire is thus held fast. The leather or other covering is now cut with spiral slits extending a part of the way through its thickness, as at *h*, and into these slits wires or strips of thin metal are wound tightly. To accomplish this, an end of the wire is taken and soldered to one of the wires at *d*, above mentioned, after which the roller being placed in a lathe, or otherwise caused to revolve, the wire or thin metal may be wound firmly into the slits, and upon issuing at the other end of the roller it is soldered in a similar manner to the other wire at *d*. In practice, a number of spiral wires (say four) are applied to a corresponding number of slits, their soldered ends starting at intermediate points around the circumference of the roller. The second set of spiral lines *i*, merely represent the ordinary biting grooves cut in the leather or other covering.

The patentee claims, "the application of wire or thin metal sunk into the leather or other roller covering."

To George Bedson, *of Manchester, for improvements in spinning or twisting wire for fencing and other purposes.*—[Dated 13th August, 1864.]

This invention consists in improvements whereby the wire is "spun," or twisted, direct from the original coils, or from the galvanizing apparatus, that is, without the preparatory process of winding upon reels, bobbins, or drums, as in the usual manufacture.

The figure in Plate IV. is a side elevation of the machinery em-

ployed to effect this purpose. *a*, is the driving pulley, mounted on a shaft, which runs in a pedestal *b*. This shaft is attached to a disc *c*, connected by longitudinal rods *d*, to another disc *c**, which bears upon an antifriction roller *e*, and is supported laterally by other rollers *e**. These two discs *c*, *c**, and rods *e*, therefore, constitute a frame-work capable of being caused to revolve by motive power applied to the pulley *a*. To the disc *c**, is affixed a bracket *f*, carrying a short shaft *g*, upon which is mounted a pinion *h*, gearing into a wheel *i*, fixed, so as to be stationary, to a standard *k*. The short shaft *g*, also carries a bevil pinion *l*, taking into another pinion *m*, mounted upon a short shaft *n*, the other end of which is provided with a spur pinion *o*, gearing into another pinion *p*, mounted upon a shaft *q*, which is capable of turning in bearings carried by the bracket *f*. This bracket also carries another shaft, situate behind that seen at *q*, and each of them is provided with a roller *r*. The bevil pinion *m*, drives another pinion *s*, mounted upon a shaft supported at one end by a boss formed upon the disc *c**, and at the other end in a step *t*, carried by one of the longitudinal bars *d*. This shaft is furnished with a pinion *u*, which drives a shaft *v*, also supported by the bars *d*, and upon it is a pulley *w*, communicating motion, by means of a band *x*, to a pulley *y*, mounted upon an axis *z*, on which there is also a drum 1, for receiving the spun or twisted wires. The axis *z*, turns at one end in a socket, carried by one of the arms *d*, and at the other in a slot within which it is confined by a pin 2. Upon the withdrawal of this pin, therefore, the axis *z*, may be removed, and with it the drum 1. Upon the shaft *v*, is a worm 3, taking into a worm wheel 4, mounted upon a shaft 5, carried by bearings attached to one of the rods *d*; and the other end of this shaft is furnished with a crank pin 6, situate within a slot formed in a cross bar 7, which is capable of sliding to and fro in guides, carried by the rods *d*. To the standard *k*, is adapted a plate, pierced with a series of six holes, corresponding in number to the wires which are to be spun or twisted, with a central hole for the core wire. This plate is attached by screws, and may be changed to suit any desired number of wires.

The operation is as follows:—The wires to be twisted are not, as in the ordinary operation of spinning or twisting, wound by a preparatory process on to drums, but are conducted direct from the original coils, or from the galvanizing apparatus, to the holes in the plate attached to the standard *k*, as shown by the dotted lines, from thence to an aperture in the bracket *f*, where they are brought together; and after this they pass to the rollers *r*, which hold them within grooves, with which they are provided. Motive power being now applied through the pulley *a*, the framework, constituted by the discs *c*, *c**, and rods *d*, will be caused to revolve; and as the gearing above described, and also the drum 1, is carried by this framework, the whole of such gearing, and the said drum, will also revolve bodily in like manner, carrying with them the rollers *r*, which, by the hold they have upon the wires, will cause them to be spun or twisted around each other. The revolution bodily of the pinion *h*, will cause it to run around the periphery of the stationary toothed wheel *i*, by which means that pinion will be caused to turn upon its axis, and communicate a like axial motion to the rollers *r*, through the medium of the pinions *l*, *m*, *o*, *p*, so that the wires, at the same time that they are spun or twisted, will be conveyed

forward to the drum 1, to which they are, at starting, conducted by hand. As the spinning or twisting proceeds, the drum 1, is caused to revolve by the pulleys *w*, *y*, and a degree of rotation is imparted to the said drum slightly in excess of that required for winding on the quantity forwarded by the rollers *r*, by which means sufficient strain is put upon the spun or twisted wires to cause them to be wound in a compact form; but when this strain exceeds certain limits, then the band *x*, will slip, and the rate of winding on will decrease, and this effect will also compensate for the extra quantity taken up by the increasing diameter of the drum. During the above-described operations, the shaft *v*, driven by the pinion *u*, will impart a slow rotatory motion through the medium of the worm and worm wheel 3, 4, to the crank pin 6, which, by revolving, will cause the guide rod 7, to move to and fro; and as the spun or twisted wires pass through this guide rod, they will be distributed gradually over the breadth of the drum 1.

The patentee claims, "First,—spinning or twisting wires direct from the original coils, or from the galvanizing bath. Second,—the machinery above described for effecting the said spinning or twisting; the main features thereof being the employment of the twisting and delivering rollers, and the receiving drum turning bodily, while at the same time they revolve upon their axes."

To WILLIAM YULE, *of St. Petersburgh, Russia, for improvements in rolling mills, and in couplings for the same and other machines.*—[Dated 16th August, 1864.]

THE object of this invention is to lessen the shocks in rolling mills, caused by reversing the rolls. The invention is also applicable to other machines, in which heavy revolving pieces have their motions frequently reversed.

In Plate IV., fig. 1 is a plan of the gearing of a rolling mill, as constructed with the improved arrangement, and as fitted with a modification of the improved coupling; and figs. 2, 3, and 4 are enlarged views of the coupling. The first-motion shaft 1, is represented as fitted with three pinions 2, 3, 4. The end pinions carry crank pins, to be driven by two steam cylinders, which are not shown. 6, is the fly wheel. The pinion 3, gears with a spur wheel 7, fast on a shaft 8, mounted in bearings in the line of the shafting transmitting the motion to the rolls; and the pinion 4, gears with a spur wheel 9, on an intermediate shaft 10, which has also fast on it a pinion 11, and this gears with a spur wheel 12, having its axis in the same line as the shaft 8, but being made to revolve in the opposite direction to that of the shaft 8, by the introduction of the intermediate shaft 10. The wheel 12, giving the reversed motion, is fixed on a tubular shaft 13, which is mounted, and turns in separate independent bearings. The clutch shaft 14, is entered through the tubular shaft 13, being additionally supported by a bearing beyond it, and it receives motion by means of a clutch 18, of the usual kind, arranged in the line of and between the ends of the two wheel shafts 8, 13, which are fitted with the usual clutch pieces 19, 20. With this arrangement the driving gear can be kept in better order than when

the reverse-motion wheel is supported directly on the clutch shaft; and when the clutch details require repair, the clutch shaft 16, can be drawn back, whilst the large wheels 7, 12, and their shafts 8, 13, need not be lifted.

The improved coupling is of a composite character; the two parts of the coupling having the usual claws or segments, which, when in contact, form an unyielding connection between the parts, whilst these are arranged with some play or space between them, so that when the motion is reversed, one part of the coupling moves round a little before the segments come into contact, and, in so moving round, is resisted by a frictional appliance.

Fig. 2 is a longitudinal section of a modification of the improved coupling, as fitted in the line of shafting; fig. 3 is an inside face view of one part of the coupling; and fig. 4 is an inside view of the counterpart coupling.

The segmental claws or projections 21, formed on the one disc or coupling 22, enter segmental openings 23, formed in the other disc or coupling 24; but the segmental openings 23, are longer than the projections 21, so that, on the motion being reversed, the disc 24, must move round a certain distance before contact takes place on the other sides of the projections 21. The disc 24, is formed with lugs 25, to receive bolts, by which there is connected to the disc an iron flanged ring 26, which is applied to the further side of the other disc 22, and by screwing up the bolts it is made to grip this disc more or less, and thus occasion a frictional resistance to the moving of one disc without the other. The friction ring 26, is formed with snugs 27, which embrace the lugs 25, and cause the ring to be carried round, without subjecting the bolts to an unnecessary shearing strain. With this arrangement, the reversed motion is more gradually communicated than when the couplings cannot yield at all, whilst it has the advantage over ordinary frictional couplings that the parts come with certainty to a dead lock, after a determined amount of yielding movement has taken place; after which any extra strain, as on a plate being entered between the rolls, cannot start the coupling. One of the composite couplings is shown as applied at the end of the clutch shaft 16, of the rolling mill, and connecting it to the break spindle 28, 29, which transmits the motion to the pinion axle 30. It is preferred to make this break spindle in two pieces 28, 29, and to introduce a second composite coupling between these pieces, and an ordinary coupling box 31, between the latter piece 29, and the pinion axle 30. The two spindles 28, 29, and the pinion axle 30, are formed with grooves or flutes, and are fitted, with a little play, into the several coupling pieces, so as to form approximate universal joints, as is well understood, to allow of any little deviation of the parts. Two or more of the composite couplings may be applied on the break spindle, or at any convenient points between the rolls and the clutch spindle; and when two or more are used, the friction rings should be so adjusted as to take different strains to overcome the frictional grip of each, so that, on reversing the motion, the coupling having the smaller frictional grip will be first acted on, and then the other or others.

The patentee claims, "First,—the fixing of the reverse-motion wheel of rolling-mill gearing on a tubular shaft, supported in bearings on both sides of the wheel, and having the clutch shaft passed through it,

as hereinbefore described; and, Second,—the construction of couplings of a composite character, or combining a limited yielding with an ultimate unyielding connection, substantially as described."

To GEORGE COLES, *of Gresham-street West*, JAMES ARCHIBALD JAQUES, *and* JOHN AMERICUS FANSHAWE, *both of Tottenham, for improvements in the manufacture of tubular and hollow articles.*—[Dated 17th August, 1864.]

THIS invention relates principally to those kinds of articles which are required to be flexible—such, for instance, as tubes or pipes for various purposes, garden or fire-engine hose, and cups or vessels for containing liquids. The invention is also applicable to the manufacture of rigid, or nearly rigid, articles of the same class, and also for making sword scabbards, gun cases, and other hollow articles.

In carrying out the invention, a core is first made on which to form the article, and which, if a flexible tube of considerable length is required, must be made flexible. For vessels of capacity, however, from which the core may easily be withdrawn, it is not essential that the core should be elastic or flexible, and such core may, therefore, be made of iron or other metal.

Supposing it is desired to produce a length of the improved tube or hose, a flexible core is first prepared by covering a rope of suitable size with sheet rubber or gutta-percha, so as to form a smooth surface, which must now be coated with French chalk, to facilitate the withdrawal of the core after the tube has been made thereon.

In Plate ., fig. 1 represents a tube being made on one of these flexible cores, which is seen at *a*,—*a*¹, being the india-rubber covering of the same. The core, having been formed in this manner, is surrounded throughout its length with a thin strip or strips of sheet rubber, as seen at *b*. The covered core *a*, is now placed in a gimping or plaiting machine, and a covering of cotton or other fibre, consisting either of a number of single threads *c*, or a tape or narrow fabric, either woven or knitted, and of suitable width, according to the diameter of the tube to be made, is laid helically round the core. For some purposes, however, it will be preferable to place the core in a circular knitting machine, and then knit a tubular covering round it. The covering, in whatever way it may be produced, is coated with a solution of caoutchouc, and the core is again surrounded with a second covering, consisting of a series of cotton or other threads or tapes, which, however, must be laid in the opposite direction to the former threads or tapes, as seen at *d*; or, a second knitted covering may be employed. It is also proposed to make the tubular covering of a textile fabric in a machine without the core, and to place it on the core *a*, by turning it, outside in, on to the core; taking care first to cover the knitted tube with a solution of india-rubber. This latter mode of putting on the covering of textile fabric is shown in fig. 2, in which *a*, is the flexible core; *b*, the sheet of rubber, which forms the inside of the tube or hose; *c*, is the knitted or other seamless tube, which, after being solutioned on the outside, is drawn on over the core. A band of sheet rubber *e*, is then laid on, and properly secured at the edges.

Two other coverings of cotton or other threads or tapes are then laid on or plaited on in opposite directions, as before, or a covering of knitted cotton, braided or plaited fabric, is applied, and this is followed by a coating of solution of caoutchouc or gutta-percha, and an outer covering of sheet rubber or other suitable gum. If desired, a third and fourth ply of threads or tapes, with the outer coating of rubber or other suitable gum, may be added to give additional strength. When the required number of plies has been completed, the flexible or other core may be withdrawn, and the tubular or hollow article may then be subjected to the well-known vulcanizing process, which will finish the article.

As a modification of the above, the core may be enveloped in a piece of knitted fabric, the selvages of which may be secured by sewing or looping with a chain-stitch sewing machine.

The flexible core may be formed either of a common hempen rope, covered, as already explained, with a sheet of india-rubber, or it may be formed of a suitable breadth of woven fabric, rolled up in the manner shown in the sectional view, fig. 3, and covered with sheet rubber, so as to present a smooth surface.

Some articles may be formed on an iron core, and when this is the case, they may be vulcanized with the core in them, so as to prevent them from getting out of shape. Rigid or nearly rigid articles are produced in the same way, by the superposition of alternate layers or coverings of sheet rubber or other suitable gum, and cotton or other threads, or woven or knitted fabric, secured by a solution of caoutchouc or gutta-percha, and then submitting the article to the vulcanizing process for the proper length of time, according to the nature and intended use of the article to be produced.

The patentees claim, "the mode or modes herein set forth of manufacturing tubular or hollow articles by alternate layers of textile materials and sheet rubber, or other suitable gum."

To ERIC HUGO WALDENSTROM, *of Manchester, for certain improvements in machinery or apparatus to be employed in the manufacture of metallic "nuts."*—[Dated 19th August, 1864.]

THIS invention relates to the formation of the pieces of metal termed "nut blanks," which are afterwards tapped internally with a thread or screw, and are employed as a screw fastening in connection with screwed bolts. The improvements consist in the use of two metallic "die boxes," within one of which a moveable plunger is used, the other containing a stationary plunger, that is to say, the three moving parts are the two halves of the die box, and one of the plungers only. The bar of metal from which the blank is to be formed is placed between the two halves of the "die box," which are brought together by two excentrics on one rotating shaft and connecting rods, so that a portion of one half of the "die box" enters the other, thus cutting off the blank from the bar, and compressing it within the then closed die. Simultaneously with this motion, and actuated by the same excentric, the moveable plunger in one half of the "die box" proceeds forward and compresses the centre of the nut against the stationary plunger,

so as to form a hole nearly through the nut; then the other half of the "die box" moves forward, and further compresses the nut, and also presses the piece remaining in the hole against the moveable plunger, thus forcing it out, and completing the hole; the die boxes then recede, and allow the nut to fall clear, by which movement also the waste piece punched out of the nut is delivered, and the apparatus is ready to form another blank.

In Plate IV., fig. 1, represents a longitudinal sectional view of the machine for making nut blanks, showing the position of the punches, dies, and "nut box," also the relative positions of the excentrics at the time when the nut would be severed from the metal bar, and before it is finally finished; fig. 2 represents a sectional plan view of the same; and fig. 3 is a section of the nut box, dies, and punches, arranged so that the "burr" or metal in the interior of the nut is punched out during its formation.

In figs. 1 and 2, *a*, *a*, is the framing of the machine supporting the excentrics *b*, *b*, and b^1, which are driven by the pulleys and gearing *c*, *c*; the excentrics *b*, *b*, actuate the nut box *d*, and moveable punch *e*, the excentric b^1, actuating at the same time the moveable hollow die *f*, within which is placed the fixed stud *o*. Within the supporting slide *g*, of the nut box is a fixed die o^1 (kept in position by yielding elastic bearings k^1, k^1,) against which the nut is forced by the moveable die *o*: these dies o^1 and *o*, form the top and bottom of the nut during its formation in the nut box. In the slide *g*, is a slot or recess *h*, through which passes a transverse cross bar *i*, to which is secured the moveable punch *e*. This cross head is caused to move the punch *e*, with every stroke of the excentric *b*, *b*, which is effected by the ends or extremities of the slot *h*, in the slide *g*, forcing it backwards and forwards the distance required, allowing with each revolution of the excentrics *b*, *b*, a dwell or rest to the punch *e*, during which time the cross bar *i*, to which the punch *e*, is attached becomes acted upon by the buffers *k*, *k*, in the manner hereafter described.

When the excentrics *b*, *b*, and b^1, first commence revolving, the nut box is at the extreme of its back stroke, so that the excentrics *b*, *b*, cause it to advance; at this time the bar from which the nut blank is to be formed is inserted between the fixed die o^1, and moveable die *f*; then, as the excentrics continue their revolution, the nut box *d*, the die *f*, and the moveable punch *e*, are drawn or forced towards each other, and the blank is cut off by the edge of the nut box and die *f*; the punch *e*, still proceeding with the nut box punches up the metal against the fixed stud *o*, placed in the hollow die *f*. The punch *e*, at this time—that is, when pressing against the nut blank, and just before entering the same—is retarded in its progress, and caused to give an increased pressure by means of the buffers *k*, *k*, being compressed during the time the bar *i*, traverses the length of the slot in the slide *g*. The slide still advancing forces forward the punch *e*, the action of which squeezes the metal into the nut, which thus becomes absorbed, and forms a portion of the body of the nut; the punch *e*, still advances beyond the extremity of the nut, and within a short distance of the fixed stud *o*: the distance between the punch and stud contains the "wadding" or waste metal. The punch *e*, having now completed its forward stroke, is allowed to remain stationary a short time, by the pressure and

expansive action of the buffers k, k: during this interval the nut box commences its backward throw, being followed up by the moveable die f, actuated by the excentrics b^1; this moveable die f, moves forward until it overlaps the punch e, which thus severs the "wadding" from the body of the nut, at the same time squeezing or forcing the nut up against the die o^1, and clean round the punch e, so finishing and completing its formation. The nut box, still receding, now brings the end of the slot h, against the cross bar i, attached to the punch e, thereby carrying or forcing such punch and buffers k, k, back. During this backward action of the nut box and punch, the complete nut has been cleared or forced from the box by the fixed die o^1, the excentrics b^1, having also drawn back the die f; the stud o, forces from out such die the "wadding" or waste metal, the machine at this time being ready to form another blank nut. In fig. 3 the stud o, in the moveable die f, is shortened, for the purpose of allowing the punch e, to force out the "burr" or the space for "tapping" in the nut, the waste metal so forced out being received by the hollow die f, and finally delivered or cleared from such die as it is withdrawn. The bar of metal from which the blanks are cut is supported by suitable brackets, a stop being provided, against which the bar is pressed when the punch, dies, and box are withdrawn, giving the length and quantity of metal required to form a nut blank.

The patentee claims, "First,—the novel and peculiar construction, combination, and action of the dies, nut box, and punches; and Second,—the general arrangement and construction of the machine to be employed in the manufacture of 'nut blanks,' as described."

To BRICE WILKINSON BARWICK *and* WILLIAM HARTLEY, *both of Keighley, Yorkshire, for improvements in spinning machinery.*—[Dated 23rd August, 1864.]

THIS invention has reference to that part of the spinning frame known as the front top roller, and has for its object the substitution of a roller more readily manufactured and more durable than those in ordinary use, possessing, in addition, the property of greater "kindness" to the wool or other fibre under operation.

The improvements consist, first, in the use of one or more vulcanised india-rubber or caoutchouc rings, instead of the cloth and leather now in use. The rings are supported by two discs (made of cast iron, by preference), having flanges on their outer edge, and provided with centre holes to receive the shaft, which is adapted as usual to carry two rollers, and is furnished with collars towards the centre to retain the discs in position, the parts toward the outer end being screwed, in order that the outer flanged discs may, by means of such screws, be retained in their position, and the india-rubber rings be held tight between the flanges; or the inner disc may be provided with a neck on the centre sufficiently long to receive the outer disc, which, in such a case, has its centre bored out to receive the neck, the end of which is screwed to receive a nut, the two discs being tightened against the india-rubber rings as before.

In Plate IV., fig. 1 is a sectional view of a roller made on the im-

proved plan. *a*, is the arbor, carrying the discs *b*; *c*, is the india-rubber ring, held firmly between the two discs *b*, by means of the nut *d*, screwed on the arbor *a*. The collars a^1, on the arbor keep the rollers the required distance apart, and the nuts *d*, tighten the discs against the collars. Fig. 2 shows a section of the cheaper kind of roller, the rings being put upon solid iron discs *b*, which are secured to the arbor by screws b^1. Fig. 3 shows the invention applied to an ordinary wooden disc without flanges, the ring being put on tight, whilst fig. 3 shows the application of a grooved wooden disc. The discs may be of wood, iron, or other suitable material, and the rings secured by means of cement, if desired.

The patentees claim, "the application of india-rubber or caoutchouc rings for the purpose of spinning, substantially in the manner shown and described."

To EDMUND CALVERT *and* THOMAS EDMESTON, *of Walton-le-Dale, Lancashire, for improvements in parts of machinery or apparatus employed in preparing, spinning, and doubling fibrous materials, and in the apparatus for manufacturing the said parts.*—[Dated 27th August, 1864.]

THIS invention relates to those descriptions of machinery in which bobbins or tubes are employed, and consists in placing a plate over a chamber or recess formed in the top of the washer wheel or bobbin braid used for driving the bobbins or tubes. The plate has on its outer edge one or more projections, which are fitted into recesses on the outer edge of the washer wheel or bobbin braid, so that both revolve together. There are also one or more raised parts or projections on the plate, for fitting into corresponding slits in the ends of the bobbins or tubes, and causing them to revolve.

In Plate IV., fig. 1 is an elevation, with part in section, showing the application of one of the improved plates to one of the washer wheels or bobbin braids used in machinery for preparing, spinning, and doubling fibrous materials; fig. 2 is a plan of the washer or bobbin braid, with the plate removed; and fig. 3 is a plan of the plate detached. *a*, is the washer wheel or bobbin braid, formed at top with a circular chamber or recess *b*; at its edge is a circular ledge *c*, in which are recesses *d*, fig. 2. The plate is marked *e*; it has at its outer edge projections *f*, fig. 3, and at the top raised projections *g*. The circular edge of the plate rests in the ledge *c*, and the projections *f*, in the recesses *d*, so that the plate is held to and turns with the wheel, and at the same time forms a lid or cover to the chamber *b*, the projections *g*, being fitted into slits in the ends of the bobbins or tubes. Flannel or other fibrous material, saturated with oil, is placed in the chamber for lubricating the spindle and washer wheel, and the plate covering the chamber prevents fibres and dust from becoming mixed with the oil, and the bobbins or tubes from becoming oily and dirty. The projections or drivers on the top of the plate can turn the bobbins or tubes with steadiness.

The apparatus for manufacturing the improved plates *e*, is as follows:—In an ordinary screw lever or excentric punching machine

is fixed a die, having a circular hole in the centre corresponding in size with the hole required in the plate, and also one or more rectangular or other shaped holes corresponding in shape with the raised parts required on the top of the plate. In the ram or slide of the punching machine is fixed a punch, the centre or nipple of which corresponds in size and form with the hole in the centre of the die before mentioned. The upper part of the punch is of sufficient diameter to admit of fitting into it one or more small punches corresponding with the rectangular or other shaped hole or holes in the die. If it is required to make the raised parts on the plate square, the bottom of each of the small punches must also be square, with only three cutting sides, the fourth side being rounded or inclined, in order that the punch shall not cut the metal on that side, but bend it over as a burr, and raise it to a perpendicular position as the punch proceeds downwards, and thereby form one of the raised parts or projections on the top of the plate. The first operation consists in punching the central hole, and forming one or more raised parts during one downward movement of the ram or slide of the punching machine. For the next or second operation a die is fixed in the punching machine, having in it a hole corresponding with the required form and size of the external circular edge of the plate, and also having slots or grooves cut into the outer circumference of the hole in the die to form the projections required to fit the recesses in the edge of the washer wheel.

In the ram or slide of the machine is fixed a punch, which fits the hole in the die, and has at its bottom end a nipple or projecting part fitting the central hole formed in the first operation, and having through it a slot or hole for holding cross punches or cutters corresponding with the slots or grooves in the outer circumference of the hole in the die, and the punches and dies for the first and second operations can be made from solid steel, or in parts fitted together. For performing the second operation it is only necessary to place the central hole punched in the first operation upon the nipple of the second punch, so that as the ram or slide descends, the punches and dies will shape the external edge of the plate and complete its manufacture.

The patentees claim, "the application to the tops of the washer wheels or bobbin braids of metal plates or platforms having projections on their outer edges, and raised parts or projections on their tops; and also the dies and punches for forming the said plates or platforms with their raised parts or projections, as all such improvements are herein described and illustrated."

To JOHN LONES, *of West Bromwich, Staffordshire, for improvements in coating iron with steel.*—[Dated 30th August, 1864.]

THIS invention relates to the coating of bars or rods and tubes of iron, of various forms, with steel.

In Plate IV., fig. 1 represents, in cross section, a square bar of iron, enclosed within two bars of steel, rolled of the form of the iron bars called angle iron. The bar of iron is marked *a*, and the two angular bars of steel are marked *b*. The two bars *b*, *b*, surround the bar of iron *a*, on its

four sides, and when the pile *a*, *b*, *b*, is raised to a welding heat and passed through a pair of properly shaped rolls, the bars *b*, *b*, are welded to the bar *a*, and the said bar *a*, is coated with steel on all sides, except at its ends. Fig. 2 represents, in cross section, a flat pile, for making steel-coated bars of iron. In this figure, the iron bar is marked *c*, and the two angular bars of steel are marked *d*. Each of the bars *d*, *d*, has a long side and a short side, in order to make it fit the bar *c*. The pile *c*, *d*, *d*, is heated and welded by rolling. Fig. 3 represents, in cross section, a pile to be made by welding into a steel-coated bar of iron. In this figure *e*, represents the bar of iron, and *f*, *g*, the bars of steel, which latter are of a trough shape, and of such a figure as to cover one-half of the iron bar *e*. The iron bar *e*, being enclosed between the steel bars *f*, *g*, in the manner represented, the whole is raised to a welding heat and welded together.

The pile, fig. 3, may be modified in the following manner:—Instead of enclosing the iron bar in two trough-shaped steel bars of similar form, one trough-shaped steel bar, of sufficient depth, and a flat steel bar may be employed. Thus the sides of the trough-shaped bar *g* (fig. 3), may be of a depth equal to the depth of the iron bar *e*,—that is, they may extend to the line *h* (fig. 3); the trough-shaped steel bar *f*, being replaced by a flat bar of steel.

Figs. 4 and 5 illustrate another method of steel-coating bars of iron, according to this invention; fig. 4 representing a compound steel and iron bar which is used in carrying this modification of the invention into effect, and fig. 5 a transverse section of a pile, made by piling bars obtained by rolling down bars of the kind represented in fig. 4, as hereinafter explained. According to this arrangement, a bar of iron *i*, such as is shown in transverse section in fig. 4, has welded to its opposite sides bars of steel *k*, *k*. By means of rolling, this bar is reduced to one of the bars *l* (fig. 5),—that is, into flat bars, having steel-coated edges; and a series of the bars *l*, is piled up; flat bars of steel *m*, *m*, being placed at top and bottom. There is thus produced the pile, which, when welded, constitutes a steel-coated fagotted bar of iron. In fig. 5, the steel and iron parts of the bars *l*, are marked with the same letters as the corresponding parts in the bar (fig. 4), from which the bars *l*, are rolled.

Fig. 6 illustrates the invention as applied to the steel-coating of iron tubes or rods having a cylindrical, square, or prismatic figure; an octagonal iron tube, with an external coating of steel, being shown in transverse section. The iron tube is marked *n*, and the external coating of steel, consisting of two trough-shaped bars *o*, *p*, which, when placed upon the tube *n*, in the manner represented, enclose the tube *n*. By raising to a welding heat the tube *n*, and the coatings *o*, *p*, upon it, in the positions represented in fig. 6, and passing the whole between rolls, the tube being supported on a mandril, the iron tube and its coating become welded into one mass; the coatings *o*, *p*, being welded to the iron of the tube *n*, and the edges of the coatings *o*, *p*, being welded together at their points of junction *q*, *r*. Fig. 7 represents, in transverse section, an iron tube *t*, coated internally with steel by means of the troughs of steel *u*, *v*; or, instead of the troughs *u*, *v*, a tube of steel, of the proper figure, may be introduced into the tube *t*. By raising the tube and lining (fig. 7) to a welding heat, they may be welded

together by rolling; the interior of the tube being supported by a mandril.

Iron tubes may also be coated with steel, both internally and externally, in a similar manner.

The patentee claims, "First,—coating square or rectangular bars of iron with steel, by enclosing the said bars within coatings of steel, the said steel coatings having the figure of the bars of iron known in commerce as angle iron, whether the sides of the angular bars of steel are of equal or of different widths, and welding the steel coatings to the iron bars. Second,—coating square or rectangular bars of iron with steel, by enclosing the said bars within coatings of steel; the said coatings of steel consisting either of two trough-shaped steel bars, enclosing the bar of iron, or of one trough-shaped steel bar, enclosing three sides, and a flat steel bar covering the fourth side of the bar of iron, and welding the whole together, as described. Third,—coating iron tubes, either within or without, or both within and without, with steel, or coating bars or rods of iron with steel; the said tubes, bars, or rods being either square, circular, octagonal, or other figure in cross section, by the methods described."

To PERCEVAL MOSES PARSONS, *of Blackheath, for improvements in ordnance and projectiles.*—[Dated 2nd September, 1864.]

THIS invention relates to improvements in guns and mortars wholly or partially built up of, or strengthened by, steel or carbonized wrought-iron tubes or hoops, and its object is to impart to the tubes or hoops surrounding the inner tube or gun, or such of them as may be desired, increased strength, toughness, and elasticity, by hardening or tempering them in oil, oleaginous fluids, or other fatty or greasy matters; and likewise to place each tube or hoop on the tube or part of the gun it surrounds in a state of initial tension.

To accomplish this object, the outer tube is made smaller in internal diameter than the exterior of the tube or part of the gun it is intended to surround. It is then heated in a furnace to a clear red heat, and placed quickly on to the tube or part of the gun prepared for its reception, and both are immediately plunged into a bath of oil, oleaginous fluid, or fatty matter.

In some cases, that is, when the difference between the internal diameter of the outer tube and the external diameter of that on which it is to be placed is small enough to admit of it, the outer tube may be tempered by heating it and plunging it into oil by itself first, and then reheated to a temperature that will not injure its temper, placed on the tube or part of the gun prepared to receive it, and cooled or allowed to cool; or it may be forced on by hydraulic or other mechanical pressure, either when cold or slightly heated.

The inner tube is also preferred to be tempered in oil before the surrounding tube or tubes or hoops are placed on it. The patentee claims the combination and methods described of tempering all or any of the tubes surrounding the inner tube or gun, and likewise placing them on the tube or part of the gun they surround in a state of initial tension.

The object of the improvements in projectiles is to produce them sufficiently hard and strong, at a cheap rate, to penetrate armour plates. For this purpose they are cast from suitable cast iron or cast iron mixed with wrought-iron or steel, in sand, loam, or metal moulds, by any of the usual well-known methods, and while sufficiently hot removed from the mould and plunged into a bath of oil, water, mercury, or other suitable liquid; or they may be heated in a furnace to a suitable heat, after they have been cast, by any of the ordinary methods, and, if necessary, shaped or otherwise prepared or finished, and plunged into the liquid. The kind of liquid used will depend upon the quality of iron the castings are made from, and the degree of hardness or toughness it is desired to impart to them. The temperature also at which they are cooled will exercise considerable influence in these respects; it is therefore impossible to give any definite instructions on these points, but it may be stated that the use of oil increases the strength to resist impact and toughens the metal considerably, as well as adding to its tensile strength, if quenched in it at a low temperature, and to its hardness if cooled at higher temperatures; whereas the general effect of water is to make metal of similar quality hard, but at the same time somewhat brittle.

When the strength of the projectile is to be taxed to the utmost, that is, supposing a projectile of comparatively light weight is to be fired at strong armour plates, it should be quenched in oil at a clear or bright red heat, the metal being of a strong medium quality between hard white and soft grey metal, and generally, if the metal is in its natural state harder, less heat may be used, and *vice versâ*. If the projectile is larger in proportion, and made of strong grey metal, and the surface only requires to be made hard, it may be quenched in water or mercury.

Under this part of the invention the patentee claims, "the construction of projectiles for ordnance made of cast iron or cast iron mixed with wrought iron or steel, cast by any of the ordinary methods, and strengthened, toughened, or hardened by plunging them, while in a sufficiently heated state, into oil, water, mercury, or other suitable liquid."

To William Henry Perkin, *of Sudbury, Middlesex, for improvements in preparing colouring matters for dyeing and printing.*—[Dated 6th September, 1864.]

In preparing colouring matters for dyeing and printing, the patentee takes the substance known as rosaniline, and mixes it with the compound or derivative obtained by the action of bromine or bromine water on turpentine; the bromine derivatives of its isomers, such as oil of lavender and others, may also be employed. He then heats the mixture together with alcohol, wood naphtha, or methylated spirit, in a closed glazed vessel to a temperature of from 140° to 150° centigrade, and retains it at this temperature for about eight hours.

If the object be to produce a blue violet, one part of brominated turpentine, one part of rosaniline, and six parts of wood naphtha, methylated spirit, or alcohol, are mixed together and placed in an iron vessel well glazed on the inside, and furnished with a cover glazed on the

under side, and capable of being secured to the vessel by screws, so as to close the vessel perfectly vapour-tight. The vessel with the mixture in it being thus closed, is heated to a temperature between 140° and 150° centigrade, and is kept at this heat for eight hours or thereabouts. The vessel is then allowed to cool; the contents, when diluted with methylated spirit or other convenient solvent, are ready for use, and the colours may be employed in dyeing and printing in the same way as other aniline dyes now well known.

If a somewhat redder colour be required than that produced by the above process, the proportions may be varied—three parts of rosaniline, two parts of brominated turpentine, and fifteen parts of spirit being employed, or the proportion of rosaniline may be somewhat further increased if desired; or, on the other hand, if a bluer colour be required than that produced with equal parts of rosaniline and brominated turpentine, the proportion of brominated turpentine may be somewhat increased.

In preparing the brominated turpentine, the patentee takes a half-gallon bottle (a Winchester quart), and fills it half full of water. He then pours in bromine until the bottom of the vessel is covered to the depth of about an inch and a half. On the surface of the water he pours a thin layer—say, one-eighth of an inch thick—of oil of turpentine, and afterwards shakes the bottle, at first carefully to avoid too violent an action. When all the turpentine is absorbed, he pours on another layer, and proceeds as before, and so goes on until all the bromine is combined, as is seen by its ceasing to colour the water. The brominated turpentine sinks to the bottom of the bottle, and the water being poured off from it, it is washed free from acid, first with a weak solution of potash, and then with water. Afterwards, when the water is poured off, it is ready for use.

Although it is preferred to prepare the brominated turpentine in this manner, it may be otherwise prepared, as by dropping oil of turpentine into bromine until there appears to be no further action, and then washing the product with potash and water as before.

To PAUL EMILE PLACET, *of Paris, for an improved process of engraving.*—[Dated 8th September, 1864.]

THE object of this invention is to produce, by means of photography, designs in relief, or sufficiently prominent or resisting for employment as a reserve (*réserve*) in the different methods of engraving. Upon a metal plate is spread a coating of a mixture composed of albumen (say 100 parts, more or less), bichromate of potassa or of ammonia (say 10 parts), and a small quantity of glycerine or sugar; a few drops of ammonia may also be added to clear the mixture. After drying, this plate is exposed to the action of light, under a plate (*cliché*) or surface carrying the design to be engraved, and afterwards dipped in water. The design appears in relief forming a reserve, and the metal is plain or bare wherever the light has not acted upon it. Instead of albumen, any animal or vegetable matters may be employed—such as bitumen, resin, gum, gelatine, dextrine, gluten, casein, and others, rendered sensitive to the action of light by one or several salts of gold, silver,

uranium, chromium, iron, or bisulphurets, iodurets, or other like agents. The parts not covered or reserved by the matter forming the design may be treated in many ways, according to the object for which they are intended. (In some cases, before commencing the other operations, it is well to apply powdered resin to the plate, to form a ground.) They may be gilt, in order that the design may be acted on by the electro-galvanic process, or by acids or other agents; they may be amalgamated and brought up in relief by means of amalgams of copper, or of metals fusible at a low temperature; they may be covered with platinum, iron, or oxdised copper. The design itself is removed by any convenient agent, it is then amalgamated and brought up in relief, as above described, by means of copper amalgams or otherwise; or the plate may be inked after having been amalgamated, and impressions may then be struck off as in ordinary lithographic printing: the mercury repels the ink, and acts as a reserve (*épargne*). Or the plain or bare parts may be iodized, and then inked, to enable impressions to be taken as in lithography; the ink remains only on the iodized parts: this inking may even be performed without iodizing the plate. Or, the plain or bare parts may be covered, by the electro-galvanic process, with a layer, more or less thick, of metal. The design acts as the reserve, and the result according to the thickness of the metal deposited, and the plate (*cliché*) employed is an engraved plate or block in intaglio or in relief, which may be employed in printing or for ornamenting. If the action of the electro-galvanic process be prolonged, the deposit covers the design by degrees, and finally altogether; on afterwards separating the two plates, there will be found, sunken or in intaglio, a perfect reproduction of the design, which may be employed in printing. The reserve (*réserve ou épargne*), obtained as above described, may be applied in numerous ways; for example, the metal partially deposited on the plate may be brought up in relief by means of collodion, varnish, gelatine, or other similar material, whereby a photographic plate is obtained, in which the black parts are formed by the deposited metal. This design, formed in metal, may be employed for a variety of purposes.

By the process above described, a design on glass is attained, forming a reserve to the agents employed to bite out or to deposit metal. By applying the usual methods of engraving to this photographic reserve, many of the kinds of engraving in intaglio and in relief, used in printing and ornamenting, are obtained.

To EDWARD JOSEPH WILLIAM PARNACOTT, *of Leeds, for an improved manufacture of artificial stone; applicable to the cutting of metallic surfaces.*—[Dated 27th October, 1864.]

THE object of this invention is to obtain a factitious stone, which may take the place of the ordinary Turkey, Water of Ayre, and Arkansas stones, used for sharpening cutting tools and for kindred purposes.

The patentee takes the chips and other fragments and dust obtained in preparing the stones used for lithographic purposes, and having reduced this refuse to fine granules, adds thereto fine emery powder, borax, and saltpetre, and thoroughly mixes them in a suitable mill.

The mixture, thus obtained, he moulds to any required shapes, for example, cutting and polishing tools, and submits the same, first, to hydraulic pressure and then to furnace heat, whereby the hardness and consistency of stone is imparted to the moulded articles. The following proportions will produce a good result:—Take of powdered lithographic stone 12 oz., of borax 2 oz., of saltpetre ½ oz., and of very fine emery 2 oz. Place these substances together in an ordinary incorporating mill, with edge runners (such as is used for preparing and mixing mastic and sand)—the pan of the mill being heated by means of steam or gas—and subject the substances to the action of the mill until they are well mixed and incorporated; then remove the compound thus formed, and place it in strong iron moulds, for the purpose of being submitted to pressure. These moulds will take various shapes and forms, to suit the purposes for which the artificial stone is to be used.

The pressure found necessary to effect a proper consolidation of the compound may be conveniently given by means of a strong hydraulic press. The amount of pressure which has proved satisfactory is about 20 tons per square inch of surface of the moulded article. When the requisite mechanical consolidation of the moulded article has been thus obtained, the moulded article is subjected to a white heat, in any suitable construction of furnace, or to such a heat as will serve to fuse the borax and saltpetre, and effect the binding together of the granules of stone and emery. As a guide to the operator, it is stated that the time required for attaining this object will be from half an hour to one hour.

To prevent the warping and running of the moulded compound under this heat, it is found desirable to clamp it in moulds made of plumbago, fire-clay, or other like heat-resisting material before placing the moulded articles in the furnace.

When it is required to produce cutting or polishing wheels, hones, or other like articles with a less cutting power than those made from the before-named mixture, ordinary chalk is substituted for a portion of the lithographic stone granules; the proportions of the chalk and the granules being about equal.

The patentee claims, "manufacturing artificial stone in the manner, and for the purpose, above described."

To SIEGERICH CHRISTOPHER KREEFT, *of Fenchurch-street, for improvements in the manufacture of iron and steel,—being a communication.*— [Dated 15th November, 1864.]

THE object of this invention is to impart homogeneity and a compact molecular arrangement to cast iron, cast steel, and to Bessemer metal, and thereby to give increased strength to the articles manufactured therefrom. To attain this end, a powerful current of electricity is applied to the metal while in a state of fusion, the current being obtained either from a voltaic battery or an induction apparatus. The electric current is applied by means of carbon points connected with the wires of the voltaic battery or induction apparatus, the points being brought into contact with the metal while it is being run off. The

metal is thus caused to assume (while in a state of fluidity) the desired homogeneous and compact molecular arrangement, which arrangement it retains after cooling.

By applying the electric current during the running off of the fused metal—and more especially the metal obtained by Bessemer's process, and the cast steel produced in furnaces with saggars—the occurrence of flaws or bubbles is prevented, as the molecular movement set up by the electricity prevents their formation.

The metals thus treated acquire a tenacity superior to that of iron and steel manufactured and cast under ordinary circumstances. The effect of this treatment is also to give to the metals thus acted upon a perfect magnetisation, which renders possible the economical construction of magnets.

The patentee claims, "subjecting manufactured iron and steel, while in a state of fusion, to the action of electric currents, for the production in cast iron, cast steel, and Bessemer metal of a homogeneous and compact molecular arrangement, as described."

To JOHN STENHOUSE, *of Rodney-street, Pentonville, for improvements in rendering certain substances less pervious to air and liquids, and also less liable to decay.*—[Dated 31st August, 1864.]

To render substances less pervious to air and liquids, and also less liable to decay, the patentee takes paraffine, or mixtures of paraffine with beeswax or with any of the vegetable waxes, or mixtures of paraffine with stearine, stearic acid, and tallow, and to the paraffine, or mixtures, he adds from 5 to 30 per cent., usually 20 per cent., of linseed oil, nut oil, poppy oil, hempseed oil, or any other of the drying oils, either with or without solutions of caoutchouc or gutta-percha, in a drying oil, usually rendered more siccative by heat or any other of the known processes. The paraffine and its admixtures, with waxy or fatty substances, may be incorporated with the drying oils by melting them together and pouring the mixture into suitable moulds, in which they are left to solidify, so as to form blocks or pieces of any convenient size. These mixtures of paraffine are applied to textile fabrics in the following manner:—A plate of iron is kept heated to such a temperature as will melt the paraffine mixture easily, and over it is stretched the fabric intended to be coated. Upon the cloth a block or piece of the paraffine mixture is rubbed until it is sufficiently impregnated, and in such a manner as to coat the surface as evenly as possible. After this treatment, it is compressed by hot rollers, or hot flat-irons, in order to distribute the paraffine mixture more equally among the fibres. The thorough incorporation of the paraffine mixture with the cloth is completed by calendering between hot metallic rollers. The paraffine mixtures are applied to one side of the fabric only, or to both, according to the amount of impregnation which it is wished to communicate. The paraffine mixture may also be heated in suitable vessels, and employed at a temperature varying from about 150° to 212° Fahr., and then applied by brushes to the cloth, and the operation completed by pressure with hot flat-irons, or by passing it between hot rollers.

If any of the above-mentioned fabrics are to be rendered more im-

pervious than could be effected by a single treatment with any of the mixtures herein described, the patentee proceeds as follows:—After the fabric has been treated by the employment of any of the mixtures, it is exposed to the air for from six to ten days, in order to enable the mixture thoroughly to set. When this is effected, a coating of drying oil, containing a small quantity of paraffine, about five per cent., may be applied, or drying oil alone. When this has also become thoroughly set, successive coatings of drying oil are applied, in the same manner, until a sufficient thickness has been obtained. If the fabric has an open texture, the pores which the paraffine may have left open may be closed by rubbing into them small quantities of lampblack, ochres, zinc white, pipe-clay, or similar powders made into a thin paste with drying oil. These are applied immediately to the paraffined surface, the coats of oil being subsequently laid on. In this way a variety of colours are also incidentally produced. The process just described is particularly applicable for the manufacture of such articles as capes, tarpaulins, tilts, &c.

When it is desirable to diminish the inflammability of any of the above mentioned fabrics, treated as above described, they are steeped in solutions of alum, borax, sal ammoniac, or sulphate of ammonia, and, when dried, the paraffine, combined with drying oils, is applied to the before-mentioned substances; or the paraffine and the above-mentioned admixtures may be applied in the first place, and the solutions for diminishing inflammability may be afterwards applied.

When treating leather in sheets or skins, the patentee gently heats it to a temperature just sufficient to melt the paraffine mixture easily, this should not exceed 145° Fahr. He then rubs over it, usually on the flesh side only, solid paraffine mixture until the desired amount of impregnation is effected. The heat is continued until the whole of the paraffine mixture has been absorbed by the leather.

Sheets of leather can likewise be impregnated with the paraffine mixture by immersing them in a bath of melted substance at a temperature not exceeding 145° Fahr. Leather may also be impregnated with the before-mentioned paraffine mixtures, dissolved in light coal tar, naphtha, petroleum oil, or bisulphide of carbon. When these solutions have been made in the usual way, by gently heating them, the leather is steeped in them, or they are applied to the leather by means of a brush or other suitable instrument. When the solvent has evaporated, the leather will be found uniformly impregnated with the paraffine mixture, and the incorporation of the paraffine mixture may be rendered still more intimate by the application of a gentle heat.

The patentee claims, "treating fabrics and substances with paraffine and drying oils, and likewise with paraffine and its admixtures, with waxy and fatty bodies also combined with drying oils, as above described."

To James Fleming, *of Glasgow, for improvements in the treatment of tobacco leaf, for the extracting of juice or liquor therefrom.*—[Dated 8th September, 1864.]

The tobacco leaf, after having been ground or cut, is put into any given number of cisterns, communicating with each other by pipes, and placed conveniently for the transmission of the liquor, juice, solution, or extract from one to another by means of gravitation. The cut leaf is then subjected to the action of either cold or hot water, which, being applied to the tobacco in one of the cisterns, passes gradually from one to another by the connecting pipes throughout the whole, or some of the whole, series by means of gravitation. The water may be caused to pass by pressure of air, forcing, or suction; and the extraction or dissolving of the soluble constituents of the tobacco may be facilitated by such pressure, forcing, or suction. The liquor, in its progress through the successive vessels, becomes more and more impregnated with the soluble constituents of the tobacco, and acquires increased strength and specific gravity; and it may be drawn off by any usual apparatus from any of the vessels, according to the strength of the solution which may be wanted.

The patentee claims, "the treatment of tobacco by a combination of vessels and the application of water, as above described, for the purpose of extracting the juice or liquor and soluble constituents from tobacco."

Scientific Notices.

MECHANICAL ENGINEERS' SOCIETY.

(*Continued from page* 43.)

The next paper read was "*On improvements in heavy tools for general engineering and iron ship building work,*" by Mr. James Fletcher, of Manchester.

Forty-five years ago, at the commencement of the writer's career as a mechanic, tools were of a very rude and primitive description, the lathe and drill being about the only ones then in general use; slide lathes were possessed only by a few persons, being made with great labour and expense, and very inferior in point of workmanship.

The introduction of the planing machine, however, and its subsequent development effected an entire change in the manufacture of tools and machinery of every class, giving the means of carrying out with facility many works which had been left unattempted previously as too expensive or impracticable, and opening the way for improvements and invention generally; and, in a short time, these machines became indispensable in every workshop. The slide lathe became then compara-

tively easy of manufacture, and in conjunction with the planing machine and self-acting drill formed a most important feature in the advancement of engineering work. Still much remained to be effected: a large proportion of work was done by hand, especially the smaller portions of machinery, until slotting and shaping machines were brought into use, and special tools adapted for all parts where a quantity of work was required to be produced. By the gradual introduction and perfecting of the regulator screw, the wheel-cutting engine, standard gauges, large surface plates, long straight edges, and scraped surfaces, combined with the improved tools, not only was the amount of manual labour considerably diminished, but the work was done more expeditiously, and a much greater degree of accuracy was attained, whereby the workmanship in all classes of machinery was remarkably improved, and at a great reduction in cost. As engineering skill was brought to bear on schemes which could not previously have been carried out, so were tools enlarged and new ones invented, to meet the exigencies of new works; until engineers and others became really dependent for the accuracy and execution of their work upon the tools that could be employed for the purpose. The steam engine, with all the inventive genius that has been concentrated upon it, would, without these tools, have still been most imperfect in construction, and would have formed a wide contrast to the engines erected at the present day, in point of excellence of workmanship, durability, and cost. Many instances could be given where tools, of unusually large dimensions or the most minute description, are indispensable for the execution of the work required.

The great change which has taken place in the substitution of wrought iron for wood or cast iron, especially in ship and bridge building, is a subject worthy of special attention. In ship building, the use of wrought iron has advanced with such rapid strides during the last twenty years, as to cause a complete revolution in the trade. The transition was so sudden and the demand so great, that much difficulty was experienced in procuring a sufficient number of the necessary class of workmen, until those who had been previously employed as shipwrights in building wooden vessels were, in a short time, enabled, by the assistance of improved tools and appliances, to compete with more practised hands, and to cope easily with the heavy modern work. Improvements in the construction of iron ships were then rapidly developed. New tools were called for and produced, by means of which the work has been materially improved and facilitated; the edges of the plates are now planed, to make perfectly fitting joints, and multiple drilling machines are rapidly coming into use for drilling a large number of holes at once in the plates or keel bars.

Another important feature, in connection with improved tools, is the direct application of steam power to individual machines, especially those for the purpose of punching and shearing plates or cutting bars, &c., by the combination of a small steam engine with each machine; thus rendering the machines portable, entirely self-contained, and independent of other sources of driving power, and thereby saving, in many instances, the necessity of running a large engine and quantity of shafting to drive only one or two machines, when pressed for the work upon which they are engaged, and entirely dispensing with shafting and the usual attendant expenses. By this means, and by the use of an under-

ground steam pipe with branches at convenient points, either in workshops or along the sides of docks, these machines may be moved about to any part required, and thus obviate the inconvenience and loss of time in carrying work to and from the machines. Steam pipes of great length are now being used, and are found very satisfactory for purposes of this description; and this plan makes a much more convenient and less costly arrangement than shafting, which requires constant attention.

In the earlier construction of the lathe, the slide rest was the first great step towards the principle of the slide lathe, and no doubt led to that invention, which was considered impracticable before planing machines were made of sufficient magnitude to plane a lathe bed of even small dimensions. A few slide lathes had indeed been made, the beds of which were composed of a timber framing, covered with iron plates on the upper side to preserve the surface, similar to those which were previously used for the ordinary hand lathes, with the exception that the outer edges of the iron plates were made of suitable shape to form the V's for the carriage to slide upon. It was not, however, until some time after the introduction of the planing machine that—the cost of workmanship being considerably lessened—slide lathes came into general use, and their utility was fully acknowledged, and attention directed to their improvement.

The application of a screw to the slide lathe, so as to render it capable of both sliding and screw-cutting, was the next important improvement; and a great amount of time, perseverance, and capital was expended by a few persons in endeavouring to perfect this portion of the lathe. A short screw was first made, as accurately as possible with the rude means then possessed, from which one was cut double the length, by changing the turned bar end for end in the lathe after cutting one half. Subsequently, by following out this principle, screws were capable of being made of any length required.

After this the surfacing motion was introduced; and also the use of a shaft at the back of the lathe, in addition to the regulator screw, for driving the sliding motion by rack and pinion, instead of both the motions of sliding and screw-cutting being worked by the screw alone. For it was found that the threads of that portion of the screw nearest the fast headstock, being most in use, were worn thinner than the other parts; and, in consequence, the lathe did not cut a long screw with the degree of accuracy which it otherwise would have done.

Thus, step by step, improvements were gradually brought forward; the four-jaw and universal chucks and other important appliances were added, so as to render the lathe applicable to a great variety of work, even cutting spiral grooves in shafts, scrolls in a face plate, skew wheels, and also turning articles of oval, spherical, or other forms. The duplex lathe, with one tool acting in front and the other behind the work, is also found to be a very useful arrangement for turning long shafts, cast-iron rollers, cylinders, and a great variety of work, where a quantity of the same kind and dimensions has to be turned.

An improved lathe, referred to by the author, and designed for the purpose of turning long shafts, screws, or other articles, had a bed 40 feet long, cast in one piece and planed the entire length at once. It is provided with two pairs of headstocks, placed right and left hand,

each pair having its own carriage and tool rest, and working entirely independent of the other; the one pair being 15 inches high to the centre, and the other 12 inches high. In connection with the larger headstock is a regulator screw, running through the entire length of the bed, by means of which, when the other headstocks are removed, a screw, 35½ feet long, may be cut at once. The smaller headstocks, by means of a separate shaft at the back of the lathe, are capable of sliding an article 25 feet long, and can also, if required, be provided with a screw-cutting arrangement. Thus this lathe possesses the advantages of being used as two lathes for work of an ordinary character, but at the same time a very long shaft may be turned when required. In many workshops a long lathe is an absolute necessity, although the whole length of the bed may not be required many times in the year; and unless some similar arrangement to the one above described is adopted, a large portion of the lathe bed, taking up valuable space, would remain idle and useless the greater portion of the time. Again, in sliding long shafts, the two carriages and tools may be in operation at once upon the same piece of work, and thus economise time. The headstocks being placed right and left hand, the loose headstocks are thus able to accomodate each other to the different lengths of work; thereby avoiding the necessity of moving the fast headstock and top cone pulley when any work above half the total length of the bed is to be turned.

For turning large marine-engine crank shafts or other articles up to 40 tons weight, or screw propellers up to 20 feet diameter, the author referred to a slide lathe, the headstocks of which are 4 feet 6 inches high from the face of the bed, which is 40 feet long. The main driving spindle is of cast iron, 18 inches diameter in the front bearing and 12 inches in the back bearing, arranged as an ordinary treble-geared lathe, which can be worked single, double, or treble power. The cone pulley, the largest speed of which is 3 feet 6 inches diameter by 6 inches wide, runs loose upon the spindle. The face plate is 12 feet diameter, and has on the back a large internal toothed wheel. By means of two pairs of driving pulleys on the countershaft, the lathe may be worked at thirty different speeds, to suit the diameter of articles to be turned. The fast headstock casting is in one piece, and, without spindle or appurtenances, weighs 11½ tons. It is secured to the bed by the tie plates. The bed is 10 feet wide over all, and is composed of two lathe beds, each cast in one piece 40 feet long, and held firmly in a parallel position by distance feet or foundation plates, having strips and bolts to bind the beds in their places. When it is required to move the bed endways, to accommodate any large article on the face plate, the strips in the distance feet are slackened, so as to allow the two long beds to slide through them, the motion being given at the end by means of worm wheels and screws. The end foot or distance piece nearest the fast headstock is fixed to the long beds, and travels with them upon the tie plates, so as to support their ends whilst turning articles on the face plate. Two self-acting sliding carriages are employed, upon one of which is a slide rest of ordinary construction and great strength; the other carriage has a rest made very narrow, with a wrought-iron tool slide, and is for the purpose of turning out crank sweeps. The self-acting motion is driven by a strap from the spindle to a pulley at

the back of the lathe, and is provided with a reversing apparatus, to enable the carriage to slide in both directions. This motion can be thrown out of gear independently in either of the carriages, which are provided with an arrangement for moving them on the bed by hand. An eye bolt is screwed in the front part of the loose headstock, and a corresponding one upon the nearest carriage, so that the two can be coupled by a short chain or shackle, and the loose headstock can thus be drawn upon the surface of the bed, to any required position, by the hand motion of the carriage. The total weight of this lathe, which is now in course of construction for the Lancefield Forge in Glasgow, will be upwards of 70 tons.

The planing machine is one of the most important tools in use, and has done more towards the advancement and success of engineering work than any other invention, with the exception of the lathe; and has passed through a great number of changes since its first introduction down to the present time.

In the first planing machines the table was moved by a chain winding on a drum, as in the old hand machines; but this mode was found to be very objectionable: the cut was unsteady, and when the tool was suddenly relieved at the end of its cut, the table had a tendency to spring forwards; it was also driven at the same speed both forwards and backwards, and thus a great loss of time was occasioned. This was much improved upon by the use of a rack and pinion, arranged to give a quick return motion, and also afterwards by the screw arrangement.

In some of the earliest planing machines the Vs were made inverted, evidently with the idea of preventing any cuttings that fell upon the wearing surfaces from remaining upon them. They proved, however, to possess no advantage even in this particular, as the finer portions of the cuttings still adhered; and in addition it was found that, from the motion of the table, the oil, by its own gravity, would not remain upon the surfaces, and thus caused them to cut and wear away quickly.

The writer has in use a planing machine, with a bed 54 feet long, the Vs of which have 2 inches of surface on each side, and are planed to an angle of 85 degrees. This machine has been working upwards of twenty years, and for the last six years both night and day; it has been employed during the whole of that time upon very heavy work, ranging from 5 to 20 tons. The Vs are still in good condition, apparently very little worn, and the work the machine does is at the present time perfectly true. The bed is in three parts jointed and bolted together, and the table in two parts; since, at the time it was made, there was no machine capable of planing a very long piece, and this was considered to be one of the largest then in existence.

The planing machines were further improved by the use of two toolboxes on the cross slide, and by the application of slide rests or toolboxes fixed upon the uprights, self-acting vertically, for planing articles at right angles to the tools on the cross slide. The reversing tool box is a very ingenious and useful contrivance for planing flat surfaces; but that plan is not so well adapted for general purposes. Planing machines have, like other tools, been specially adapted to a great variety of work, and the writer has made them with different numbers of tools up to as many as sixteen, all of which were in operation at once.

The great changes which have lately taken place in the manufacture of wrought-iron and steel ordnance, and the revolution they have caused in the construction of vessels of war, have called into requisition a great many alterations and adaptations of the present machines, as well as many entirely new ones. The planing machine especially has been called upon to do work of a very curious and intricate character, namely, that of planing the edges of armour plates to different curves, shapes, or angles. In most cases this has been accomplished by a pattern bar of iron or steel, placed on edge in a small chuck fixed upon the surface of the table, adjustable by set screws, and shaped to the form to which it is required to plane the edge of the plate; as the table travels, this bar, which runs between two circular rollers attached to the under side of the tool slide, moves the tool sideways, according to the amount of curve in the shaper or guide bar, the tool box being disconnected for this purpose from the screw in the cross slide.

A duplex planing machine, made by the writer, is arranged with double beds and double tables, each table having a separate set of gearing, with starting, stopping, and feed motions. There are two tool boxes on the cross slide, each of which is independently self-acting, so as to work with its own table. Thus the two tables may be used separately as two smaller machines working independently of each other, and capable of planing different lengths of work at the same time; or when planing a large article, the two tables, gearing, and motions, may be coupled, so as to form one large machine: an arrangement rendering the machine capable of doing a variety of work. Also one table may be fixed stationary as a bed-plate, to bolt awkwardly-shaped or long pieces of work upon, whilst they are planed by a slide rest fixed upon the other table. When used as one machine, both sets of straps and gearing are in operation, and are reversed by the stops of one table only, so as to ensure the straps moving at the same time.

This machine is capable of planing articles 10 feet wide and 10 feet high. The racks on the under side of the tables are 3 inches pitch, with stepped teeth; the wheel working into the rack is 3 feet 9 inches diameter at the pitch line, and is driven by a smaller pinion. By this arrangement a steadier motion is obtained; and also the pulleys and driving gear can be placed entirely behind the face of the uprights, so as to leave the front of the machine perfectly clear, that the straps may not be in the way when taking the work off and on. The pulleys being below the ground line, may be driven by a horizontal underground shaft at the back of the machine, and no straps will then be visible. The writer has made machines of this description with beds 40 feet long, to plane work up to 14 feet in width.

This machine is particularly well adapted for planing armour plates. Two plates can be planed at once on each table, one being placed upright and the other horizontal, so as to be operated upon by the tools on the cross slide and the upright at the same time; or whilst two plates are being planed on one table, the workman may be fixing two more on the other, and thus keep the machine constantly employed. One workman is sufficient to attend to both sides of the machine, thereby saving labour. By having a stationary table fixed at one side of the bed, upon which the four ends of four other armour plates are

bolted, and adding an angle bracket and slide rest upon one of the moving tables, the four ends are planed at the same time.

The slotting machine, of which the engineers in Glasgow can justly boast the heaviest examples, was originally introduced for cutting small wheels, levers, &c., mostly for self-acting mule and loom work; and was afterwards adapted to a great variety of work by the application of a circular table, which was an improvement of the greatest importance, especially in large machines for slotting or shaping large cranks or other similar work; this is now done to such perfection as to require merely drawfiling and polishing to give the work a perfect finish. Many kinds of quick return motions have been employed for the purpose of saving time in the return stroke of the tool, and to give it a regular and steady movement in the cutting direction. Of these the principal are the excentric wheels, the excentric motion, and, lastly, the lever motion, which makes an excellent and steady movement, and is now very much applied to shaping machines.

One of the large slotting machines made by the writer has a stroke of 3 feet, and the framing is capable of taking in an article 12 feet diameter; it has compound slides and a self-acting circular table 6 feet diameter. The ram moves in a vertical slide, which can be raised or lowered to suit the depth of work on the table, so as to form a support to the ram when taking a heavy cut. The motion applied to the tool slide is the lever and connecting rod, arranged so as to gain power and give an almost uniform motion in the cutting direction, and an accelerated speed in the return stroke.

In making a double lever punching, shearing, and angle-iron cutting machine, the strong hollow cast-iron frame is planed at each end, for the reception of the punching and shearing slides. The machine is put in motion by a steam engine, fixed upon the outside of the framing, and connected to a crank pin in the flywheel, driving by a pinion on the first motion shaft into the large wheel, which has cams cast on each side in opposite positions, so as to work alternately the pressing levers, which operate the punching and shearing slides. These levers work on fixed pins for their fulcrums. The punching slide is provided with a block, which can be drawn out from under the end of the lever to throw the punch slide out of gear. At the shearing end an adjustable stop is added immediately in front of the shears, for holding down the plate whilst shearing, and thus causing it to be cut square on the edge. This takes the strain of holding down the plate from the workman, and prevents short pieces of metal from getting down between the cutters and breaking the machine.

Upon the end of the centre shaft is forged an excentric, working into a block in a ram, the lower end of which is provided with suitably-shaped cutters for shearing bars of angle iron. This slide is placed at an angle of 45 degrees, and has also a disengaging motion, so as to be thrown out of gear whilst a long bar of angle iron is being put between the cutters, and set to the proper place or marks for being cut off correctly.

This machine possesses all the advantages of the old lever machine and the excentric machine combined; the former of which has long been acknowledged to be the most simple and useful. The cams which operate the pressing levers are constructed of such a shape that the

operation of punching or shearing is completed, and the slide returned to the top, in half a revolution of the machine, the whole slide remaining stationary during the other half revolution, whilst the workman is adjusting the plate for the next stroke. This enables the machine to be worked one-third quicker than excentric machines, and still leaves the workman as much time to move the plate; since in excentric machines the punch or shears is always being either raised or lowered, instead of being stationary during part of each revolution.

For the purpose of obtaining greater accuracy in dividing out the holes in bridge, boiler, or ship plates, a dividing table has been used, and machines have been arranged to punch several holes at once. This was certainly a great improvement upon the old method, since, in addition to the accuracy attained, very much more work was accomplished in the same amount of time. Still the work was not of a satisfactory description. In punching the holes the iron is disturbed or fractured for some little distance round the hole, thus weakening the plate; and in consequence of the taper which there must necessarily be in all punched holes, the rivets do not thoroughly fill up the space, especially when more than two plates are joined together.

The faults of punched work above mentioned were so apparent when wrought-iron bridge building became general, that they led to the introduction, by Messrs. Cochrane, of the multiple drilling machine, for drilling a large number of holes at once in bridge plates.

It has been found desirable to make this principle of drilling machine more universal in its application, and the following is a machine designed for this purpose:—A strong base plate extends the entire length of the machine, about 18 feet, with three circular openings along the centre line, large enough to admit hydraulic cylinders, by which the table carrying the plate to be drilled is raised and pressed against the drills with the necessary force. The end frames are bolted to the base plate, and upon them are fixed guides adjusted to each corner of the table; they also support the girder which carries the drill frames. The ends of the girder are fitted in planed grooves, and it is made in halves, which can be set wider apart without altering the gearing, by inserting cast-iron packings of the requisite thickness and longer bolts at the joint. The two halves of the girder can also be turned with the drill frames inwards if required, and adjusted to a distance of four inches apart for the two rows of holes and upwards.

Each drill is held in a separate frame. The frames are all bolted on the girder at the proper distance apart, and are moveable longitudinally to any position along the girder. Each drill spindle is fitted with an adjustable tail pin and lock nut, which receives the upward pressure of the spindle; and a conical bearing is provided at the lower end of each drill frame, which prevents the drill spindles from wearing out of truth. The drills are all turned parallel for a short distance at the upper end, and fit in parallel sockets, which admit of short drills being adjusted to the same length as longer ones, by putting some small burrs or punchings from the punching machine, of the required thickness, into the drill sockets above the drills; and the drills are fastened in the sockets by a set screw.

Each drill spindle is driven at the top by a pair of mitre wheels, which may be described as each consisting of a short section of a 3½-

inch diameter twelve-threaded screw, of which the threads are about 12 inches pitch; that is to say, each thread or tooth, if continued, would make one complete turn round its shaft in 12 inches length. A long steel shaft, 2½ inches diameter, with a groove throughout its length, passes through each drill frame, and its vertical spur mitre wheel, giving motion to each drill spindle. This shaft is driven by a pair of strong bevil wheels in the proportion of 1½ to 1, which take their motion direct from the pulley shaft, and give about 60 revolutions per minute for the drills.

The application of the spur mitre wheels in this machine for driving the drill spindles, enables the spindles to be arranged in such a manner that they are capable of being moved to suit different pitches of holes. In consequence, however, of the wheels being 3¾ inches diameter, holes could not be drilled at a less pitch than that dimension with a single driving shaft; but another application of the same mode of driving allows of the drill spindles being got to within 2½ inches from centre to centre, with the same diameter of driving wheels: this is effected by using two long steel driving shafts, instead of a single one, each shaft driving every alternate drill spindle.

The hydraulic cylinders used to raise the table with the work on it up to the drills are similar to those of hydraulic presses. A pair of strong 1½-inch diameter pumps, worked by excentrics on a shaft, force water into an accumulator, which consists of an upright cylinder fitted with a piston properly weighted; and there is a self-acting apparatus which throws the pumps out of gear when the accumulator is full. The hydraulic cylinders are connected with the accumulator by a two-way cock; and on turning the water on, the table immediately rises. When the pressure is to be removed, turning the cock back stops the pressure from the accumulator, and at the same time allows the water to escape from the cylinders, causing the table to fall immediately. The working pressure of water is about 3 cwts. per square inch, which produces a pressure of about 6 cwts. per drill. A plate is drilled in twelve to fifteen minutes. A strong parallel motion gear is fixed under the drill table to prevent it from lifting at one end when only the drills at the other end are being used, or when only one row is in use.

These drilling machines are now being used by Messrs. Kennard for drilling the plates and bars required in the main girders of the new bridge to be placed over the Thames at Blackfriars. The truth of the drilled holes is so complete that when a number of plates with holes drilled for 1-inch pins are put together indiscriminately, and four turned pins passed through the corner holes, the holes fit so accurately throughout the entire lot of plates, that a pin 1 inch diameter can be driven through the lot at any hole with a light hand hammer. In consequence of this superiority of the work, a great diminution in the cost of labour takes place in putting the parts together, saving the drifting of the holes and the strain put upon the plate which necessarily takes place when rivetting punched holes. In addition to this the fibre of the iron retains all its strength and tenacity, and there can be no doubt that the extra work of manufacture is fully compensated for by the greater strength of construction, and the decrease of cost in putting the plates together.

Several other useful machines are constructed for bridge and ship-building purposes, amongst which may be named—a machine for shearing plates up to 1 inch thick, with revolving circular shears; machines for planing plates with a travelling tool, and also with a revolving circular disc containing a number of tools; and machines for bending garboard strakes, angle iron, and deck beams for ships.

The writer next describes a nut-making machine, designed to manufacture nuts from a heated bar of iron, at a single operation, by cutting off from the bar a piece to form the blank, which is swaged into shape, and the hole punched through it while still hot. The blank is powerfully compressed between the pair of swages, while in the die-box, before the hole is punched, in order to make the nut solid and shape it with smoothness and precision; and the hole is then punched while the nut is still confined in the die-box, and under the heavy pressure of the swages, so that it is prevented from bursting or straining during the operation of punching.

The dies, swages, and punch are so fixed to the machine that they can easily be removed and replaced by others of different sizes. By this means the same machine may be used for making nuts of various sizes and shapes. Two of these machines have now been at work at the writer's works in Manchester for upwards of five years. With the aid of a good furnace, from 15 to 20 cwts. of $\frac{7}{8}$ or 1-inch nuts can be produced in a working day of ten hours, the machine running at 60 revolutions per minute. All the nuts possess the same degree of accuracy in shape, the sides being parallel to each other, and the holes being punched perfectly central whilst the nut is under pressure in the die box. The iron is fed into the machine at a welding heat, and the pressure put upon it by the swages in the die-box has the effect of closing up the fibres of the iron, making the nuts very much stronger than those forged in the ordinary way by hand. The holes punched are perfectly clean and regular, and have no scale inside them to injure or chafe the threads of the taps, when being screwed.

The author also describes a bolt-heading machine, similar in some of its principal parts to the nut-making machine. The bar of iron for forming the belt, heated to a welding state for a short distance only at the end, and of the same diameter as the screwed portion of the bolt, is inserted between a pair of open dies, divided longitudinally down the centre. The bolt is pushed up to the heading swage, the length of which is adjustable so as to measure off the iron to the correct length for making bolts with different thicknesses of head. As soon as the bar is inserted between the dies, a shearing slide, carrying one of the dies, and the cutter, is pressed forwards, and the length for forming the bolt is cut off. The second bolt is then held firmly between the dies until the formation of the head is completed. This operation is effected by the advance of a centre ram, carrying the heading swage, which compresses the heated metal so as to fill a die-box and form the bolt head. The heading swage then remains stationary whilst the die-box is drawn back clear of the bolt head; after which the swage also retires to its original position. The shearing slide is then withdrawn by leaving the bolt in the stationary half of the dies; and a knocker strikes the finished bolt, and discharges it from the dies.

This machine makes about 30 strokes per minute, and is capable of producing a bolt at each stroke, provided it be supplied with the iron at a proper heat. The bar of iron is heated only at that portion which is to form the head, the remainder or bolt end being cut off cold. The object of this is to prevent the bolts from being scaled their whole length through the action of the fire. The ram carrying the heading swage is acted upon by a cam through the intervention of a lever, through which the whole pressure is transmitted; and the bottom end of this lever is centred upon an oak beam fixed inside the framing of the machine, which, being slightly elastic, prevents the machine from being broken in the event of more iron being inserted into it than is required to make the bolt head. In consequence of this provision a bolt has been made without breaking the machine with a head as much as $1\frac{3}{16}$ inch thick, when the dies were set to make it only $\frac{3}{4}$ inch thick.

There are a great variety of special tools, for railway and machine-making purposes, which the writer has been obliged to pass over, and which would form ample material for another paper.

In conclusion, it may be remarked that the opinion is now universal that, without extraordinary strength, rigidity, and power in tools, their work cannot be accomplished either quickly or well. Accuracy in the manufacture of tools and their universal application have had a great effect in the perfection of the work executed and in the facility and economy of its performance. By the assistance of gauges for different parts of machinery, the advantages of engineering tools have been more fully realised; and no engineering work, of whatever magnitude, need now remain unaccomplished for want of tools.

Notwithstanding the length of time during which the improvement of tools has been in progress, and the great advance that has been made, it may be said that at the present time there is a wider field for improvement than ever, and a constant and increasing demand for tools of novel construction for special purposes.

The next paper read was, "*On the construction of blast furnaces and the manufacture of pig iron in the Cleveland district*," by Mr. James George Beckton, of Whitby.

Within the last ten years, the blast furnaces which have been erected in the Cleveland district have been gradually increased in size, both in diameter and height; and these alterations have thus far been attended with good results, so much so that almost all the new furnaces, now in course of erection, are being built with boshes, ranging from 16 feet to $22\frac{1}{2}$ feet diameter, and from 60 feet to 75 feet in height, from the bottom of the hearth to the filling plates at the top. Previously the furnaces ranged from 13 feet to 15 feet diameter at the boshes, and from 45 feet to 50 feet in height; the extreme increase being about 70 per cent. in both dimensions. The maximum diameter of the boshes appears not yet to have been attained; and the limit to the height will apparently be found in the strength of the coke to support the crushing force of the high column of materials in the large blast furnace. The make of pig iron has increased at the same time from 200 tons per week in the small furnaces to 300 tons in the large furnaces.

The average quantity of materials used in the production of one ton of pig iron in the large furnaces is as follows :—

26 cwts. of Durham coke,
70 cwts. Cleveland ironstone,
15 cwts. of limestone,
10 cwts. of coal for boilers, hot-blast stoves, and calcining kilns.

121 cwts. total.

or about 6 tons of materials per ton of iron made. Formerly the quantity of coke used, per ton of iron made, averaged 35 cwts., instead of 26 cwts., and the quantity of coal 20 cwts., instead of 10 cwts. The writer does not attribute the whole of the saving of fuel which has taken place to the increased size of the furnaces alone, as there are several other improvements which have combined to produce an economy of fuel in the manufacture of pig iron in the Cleveland district, of which the following are some of the principal:—

First,—the more efficient management which has taken place at the different works.

Second,—the better adaptation of engine power and hot-blast stoves to the requirements of the furnaces.

Third,—the improved system of calcining the ore, which was formerly carried on by clamping in the open air, but is now performed in properly-constructed calcining kilns.

Fourth,—the higher degree of temperature of the blast supplied to the furnaces, which was formerly heated in the hot-blast stoves to only 600° or 700° Fahr.,but is now very generally being supplied to the furnaces at a temperature of from 800° to 900°.

Fifth,—the plan of taking off the waste gas from the furnaces and burning it at the boilers and hot-blast stoves, in place of using additional coal for this purpose.

The application of the waste gas to the boilers and hot-blast stoves is becoming very general at the different works in the district; and arrangements are now being made at several of the new works in course of erection for applying it to the calcining kilns, for the purpose of calcining the ironstone. The plan in general use for taking off the gas from the blast furnace is the closed furnace top with bell and hopper, sufficiently large to charge from 8 to 10 tons of materials into the furnace at once, and with an arrangement for raising and lowering the bell by hand. The impression seems to be gaining ground that taking off the gas with the closed top, and in connection with a large chimney double the height of the furnaces, does not interfere with the operations of the large furnace, either as regards economy of fuel or quality and make of iron.

A noticeable feature in the large furnaces is the greater amount of time the materials are allowed to remain in the furnace. The capacity of the Thornaby furnaces, with 20 feet boshes and 60 feet height, is 12,361 cubic feet; the area of the boshes is 314 square feet, and the make of iron 300 tons weekly per furnace. The capacity of the small furnaces which were formerly erected, with 14 feet boshes and 50 feet height, is 5553 cubic feet; the area of the boshes is 154 square feet, and the make of iron 200 tons weekly per furnace. In the large fur-

nace, therefore, there are more than twice the quantity of materials undergoing the process heating, and also remaining a longer time in the furnace. Moreover, the area of the boshes in the large furnace being double that in the small furnace, while the quantity of iron produced by the large furnace, and consequently the quantity of blast supplied, is only one and a half times as much as in the small furnace; it follows that the ascending gases pass through the materials at a slower velocity and at a lower temperature in the large furnace. This allows the coke to descend to the zone of fusion without losing so much of its carbon in the formation of carbonic oxide, as previously in the small furnace; and hence arises the greater economy of fuel in the large furnace. To produce 300 tons of pig iron per week, the large furnace requires to be supplied with 8000 cubic feet of blast per minute, at a pressure of 3 lbs. per square inch.

Four furnaces at the Ormesby Iron Works, Middlesbrough, belonging to Messrs. Cochrane, erected in 1855, were the largest in the district at that time: the boshes are 16 feet diameter and the height is 56½ feet. The furnaces are constructed upon land consisting of mud and silt, and piling had therefore to be resorted to, in order to secure a good foundation for the furnaces. A bed of concrete was placed on the top of the piles, and six inverted arches were turned on the top of the concrete, and the brick pillars carried up, and strong cast-iron bearers fixed across the top, for carrying and binding the brickwork of the barrel and boshes. The outer shell is bound with wrought-iron hoops, fixed near enough together to prevent the barrel from cracking. The boshes are at an angle of 75° from the horizontal.

In building four furnaces, in 1858, at the Jarrow Iron Works, Newcastle-on-Tyne, a good strong clay was found for the foundations to rest upon; the brickwork was carried up to the floor line, then twelve cast-iron columns were erected, and wrought-iron casings fixed on the top of these. The casings extend from the top of the five tuyere houses to the top of the boshes, above which the barrel is bound with wrought-iron hoops supported by T irons; the latter being carried up to the top, and a flat ring rivetted to them sufficiently strong to carry the floor plates. The boshes are 18 feet diameter, at an angle of 66° from the horizontal, and the furnaces are 60 feet high.

At the Normanby Iron Works, Middlesborough, belonging to Messrs. Jones, Dunning, and Co., three furnaces were erected in 1860, upon a bed of concrete, on clay of a weak nature; they are supported on brick pillars, and hooped similarly to the Ormesby furnaces. The boshes are 18 feet diameter, at an angle of 72° from the horizontal, and the furnaces are 58 feet high.

At the Thornaby Iron Works, South Stockton-on-Tees, belonging to Messrs. Whitwell, three furnaces were erected, in 1862, upon piles, in consequence of the land being mud and silt; they stand each upon 12 cast-iron columns, and are cased with iron, similarly to the Jarrow furnaces. The boshes are 20 feet diameter, at an angle of 68° from the horizontal, and the furnaces are 60 feet high.

At the Acklam Iron Work, Middlesborough, by Messrs. Stevenson, Wilson, Jacques, and Co., three furnaces are being built on piles, in consequence of the land being mud and silt, and are each supported by 12 cast-iron pillars. The brickwork around the boshes is cased

with plates, and from the boshes up to the top the barrel is bound with hoops and T irons. The boshes are 22½ feet diameter, at an angle of 68° from the horizontal, and the furnaces are 70 feet high. These furnaces the writer believes to be the largest in dimensions that have ever been erected, and their contents will amount to no less than 1250 tons of materials per furnace. They are expected to produce each 350 tons of pig iron per week.

Mr. D. Adamson regretted that Mr. Beckton was unexpectedly prevented from being present at the meeting. With some of the blast furnaces in the Cleveland district he had himself had an opportunity of becoming acquainted; and in reference to the semiclosed plan of furnace top, for taking off a portion of the gas from the furnace throat, as used at the Thornaby furnaces, the construction of top in this case was similar to that in use at Messrs. Schneider's furnaces near Ulverstone; but although at the Ulverstone furnaces it had been found to work so successfully that the same plan was being adopted for more furnaces at the same works, in the particular instance of the Thornaby furnaces it had not been found to answer. The centre tube or brick chimney for taking off the gas was carried upon six arches springing from the inside of the furnace throat, and the charging of the materials into the furnace was done through the spaces left between the arches; and the reason of the failure of the plan at the Thornaby furnaces was that constant trouble was occasioned by the damage done to these arches in charging, owing to the large size of the material in the charges. The Cleveland ironstone was raised from the mines and supplied to the furnaces in very large pieces, and would not pay for being broken to a smaller size, on account of its friable nature, and the quantity of waste that would be made in breaking it up; and in charging the furnace with these large pieces, they broke down the arches carrying the centre tube, so that this plan had now been abandoned at the Thornaby furnaces, and they were about to have closed tops put on, of the usual construction, for taking off the whole of the gas.

Independently, however, of the trouble arising with the arches in the semiclosed plan of furnace top, it was also found at the Thornaby furnaces that the portion of the gas so taken off was not sufficient in quantity for the purposes of raising steam at the works and heating the blast, even without attempting to use any of the gas for calcining the iron. In the discussion of this subject at the Liverpool meeting, he had urged the desirability of taking off the whole of the gas from a furnace, on account of the large additional heating power then at command; and this view appeared to be confirmed by the experience in the present instance at Thornaby, and by the statement given in the paper just read that at some of the Cleveland furnaces, where the top was entirely closed, the gas was likely to be employed for calcining the ironstone in addition to heating the steam boilers and the hot-blast stoves.

The President enquired, what was the effect of the increased size of the Cleveland blast furnaces upon the quality of the iron made.

Mr. D. Adamson understood that in the larger furnaces foundry iron was made with rather less trouble than in the smaller ones;

and with considerably less fuel, according to the statement in the paper. The charge was thus lighter, and the iron was made at less cost in the larger furnaces, which was attributed in the paper to the greater length of time that the materials remained in the larger furnaces.

The President asked what size of blowing engine was used for the large furnace at the Acklam Iron Works.

Mr. D. Adamson was not aware what size of engine was used at the Acklam furnaces, but the majority of the Cleveland furnaces were supplied with blast by a number of small blowing engines, and the rest by a single large engine. With regard to the pressure of the blast, he believed 3 lbs. per square inch, or rather less, was usually about the pressure at the engine in the Cleveland district, but he doubted whether the full pressure of the blast was always obtained in the furnaces, as it had been found by applying gauges on the tuyeres at the Thornaby furnaces, that the pressure at that point was considerably below what it was at the engine. At the Norton furnaces of Messrs. Warners, near Stockton-on-Tees, the pressure originally employed of 3¾ lbs. per square inch had now been reduced to only ½ lb. per square inch; and he understood the lighter blast was preferred at those furnaces, and that a greater quantity of foundry iron was made than with a heavier pressure of blast.

The President enquired what was the usual number of tuyeres in the Cleveland furnaces.

Mr. D. Adamson replied that from three to six tuyeres were usually employed. At the Norton furnaces three large tuyeres were now used with the light blast, instead of six smaller tuyeres employed previously with the heavier blast; and from the reduction in the pressure of the blast, much less engine power was now required in blowing the furnaces for the same make of iron. At another furnace, however, in the neighbourhood, the engines had been kept loaded to 2¾ lbs. per square inch pressure, while the pressure of the blast was reduced by throttling its passage through the main by means of a stop valve; and in that instance consequently the full benefit of saving in engine power by working with a lighter blast had not been realised.

Mr. G. Thomson observed that the size of the blast furnace was a very important subject to iron makers, and one upon which experience differed a good deal; and it was therefore highly desirable to get all the information possible, in order to make a fair comparison between different sizes of furnace. One point to be enquired into was the relative quantity of iron produced and of blast supplied in the large and small furnaces. In the large furnaces, 60 feet high and 20 feet diameter boshes, making 300 tons of iron per week, the quantity of blast had been stated in the paper to be 8000 cubic feet per minute; and he enquired what was the quantity of blast supplied to the smaller furnaces, 50 feet high and 14 feet diameter of boshes, making 200 tons of iron per week.

Mr. Neil Robson did not know the quantity of blast supplied in the smaller Cleveland furnaces, but in the blast furnaces of the Glasgow district the quantity of blast supplied to a furnace about 50 feet high and 16 feet diameter of boshes was usually supposed to be about 6000 cubic feet per minute.

Mr. C. Cochrane thought the 8000 cubic feet of blast per minute, which had been stated to be the supply to the large Cleveland furnaces, must be the theoretical quantity measured by the total displacement at the blast engine, without any allowance being made for escape between the piston and the cylinder and for leakages in the blast main: for the quantity of coke consumed in the furnace—26 cwts. per ton of iron made—would not require, he thought, more than 6000 to 6300 cubic feet of blast per minute, and he could not understand, therefore, so much as 8000 cubic feet per minute being supplied to the furnace.

Mr. G. Thomson remarked that 6000 cubic feet of blast per minute would be a maximum quantity in Staffordshire, and there were many furnaces of a smaller size in that district in which a much smaller quantity of blast was supplied.

Another point upon which further information was required in connection with the Cleveland blast furnaces was the temperature of the blast in the large and small furnaces, and whether the large furnaces had been worked with the lower temperature of blast used in the smaller ones. It appeared from the paper that the blast for the larger furnaces was heated to 800° Fahr., while in the smaller furnaces the temperature had not been carried beyond 600°; and in order that a fair comparison might be arrived at between the different sizes of furnace, he should be glad to know the result of working the larger furnaces at the lower temperature of 600°, the same as the small furnaces, since the conditions of working should be made as nearly as possible the same in the different furnaces. The actual temperature of the blast, he believed, was generally much higher than was indicated by the ordinary rough test of holding a strip of lead in the blast to be melted by the heat; since, in order to melt the lead at all under such circumstances, the temperature of the blast must be considerably above the melting point of the metal, and the real temperature was, therefore, not ascertained with any approach to accuracy by the plan of melting metals in the blast. He enquired how the heat of the blast was ascertained when it was much above the melting point of lead, and whether any pyrometer was employed for showing the temperature accurately.

Mr. C. Cochrane replied, that for temperatures above that indicated by the melting of lead in the blast, a strip of zinc was used as the test instead of lead, and by that means a temperature as high as about 850° was indicated, the melting point of zinc being 770° Fahr.; for the actual temperature of the blast, when hot enough to melt either lead or zinc, was found to be as much as 80° or 90° above the melting point of the metal. This was ascertained to be the case as a general rule, whatever the melting point of the metal employed, as was shown by the aid of the improved pyrometer constructed on the principle of measuring the temperature of a copper ball heated in the blast, by immersing it in a vessel of water, which afforded the means of measuring with the greatest accuracy the highest temperatures that were likely to be met with in practice.

Mr. E. A. Cowper explained that the pyrometer referred to was an improved arrangement of that invented by Mr. John Wilson, and described at a former meeting of the institution, and was a very simple

and accurate contrivance for measuring high temperature. It consisted of a copper vessel holding exactly a pint of water, and a small cylindrical piece of copper made of such a size that its total capacity for heat should be 1-50th that of the pint of water; this copper piece was held for a sufficient time in the current of heated blast until it had acquired the full temperature of the blast, and it was then dropped into the vessel of water, when each 50° that the temperature of the copper had been raised produced a rise of 1° in the temperature of the water; and thus the real temperature was at once read off from a thermometer inserted into the water, having a properly divided scale showing 50° for each 1° of the ordinary scale. It was by this means that it had been ascertained that, when the heat of the blast was tested by a stick of metal being just melted on exposure to the current, the actual heat of the blast was about 70° to 90° Fahr. above the melting point of the metal. Thus, if lead, melting at 620°, were just melted by the blast, the heat of the blast might be taken to be about 690°; zinc melted at 770°, and would show about 840°; and antimony did not melt at less than 830°, and its melting would therefore indicate about 900°. Of course, if the stick of metal were melted quickly in the blast, it showed that the temperature was much higher than the melting point of the metal; and ordinarily the sticks of antimony of about 5-16ths inch diameter became fused in three or four seconds by exposure to the heated blast from the regenerative hot-blast stoves.

Mr. Neil Robson observed there could be no doubt as to the importance of the question of the height of blast furnaces; and it appeared from the paper a height of 70 feet had now been reached in the Cleveland district, while in the neighbourhood of Glasgow the highest furnace was only 55 feet, and generally the furnaces were not more than 42 feet high. At the Ardeer Iron Works, in Ayrshire, where there were four furnaces, each 52 feet high and 16 feet diameter at the boshes, the regular make of iron was 1000 tons per week, or an average of 250 tons per week from each furnace. Occasionally, one or two of the furnaces would make 270 tons per week, while the others might make less than 250 tons at the same time; but 1000 tons per week was the regular average make throughout the year, taking all four together. The highest make in the Cleveland district was stated at about 300 tons per week, with 60 feet height and 20 feet diameter of boshes; but, in comparison with the Scotch furnaces, the make of the larger Cleveland furnaces ought to be as much as 400 tons per week for the size of furnace used. The temperature of blast employed was in both cases from 800° to 900°, and the pressure about 3 lbs. per square inch. Hence, he thought, the cause of the smaller produce of the large Cleveland furnaces was to be sought in the materials that had to be worked, the nature of the ironstone to be smelted, and the quality of the fuel to be used. In the Ardeer furnaces the ore employed was in a great measure the blackband ironstone, and the fuel was raw coal; and he presumed these must be easier smelted than the materials in the Cleveland district, since the Scotch furnaces, though so much smaller, produced nearly as much iron in the same time.

Provisional Protection Granted.

[*Cases in which a Full Specification has been deposited.*]

1678. George Haseltine, of Southampton-buildings, impts. in sewing machines,—a communication.—*June 22nd.*

1693. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in machinery for the manufacture o horse shoe and other nails,—a com munication.—*June 24th.*

1834. Nathaniel Jenkins, of Boston, U.S.A., impts. in steam and water valves.—*July 11th.*

Cases in which a Provisional Specification has been deposited.

399. David Barr, William Henry Page, and James Clement Newey, of Birmingham, impts. in machinery and tools for making collars, cuffs, wristbands, and other articles of dress; also adapted for cutting metal blanks.—*February 13th.*

600. James Spence, of Liverpool, impts. in apparatus for operating engineers' and carpenters' tools, by hand or other power.—*March 3rd.*

642. Frederick Tolhausen, of Paris, impts. in breech-loading firearms,—a communication.—*March 8th.*

758. Gerald Ralston, of Tokenhouse-yard, impts. in the mode of forming and making clothing,—a communication.—*March 18th.*

967. Jean Isidore Darribet, of Dax, France, impts. in seats of water-closets.—*April 5th.*

1118. Robert Griffiths, of Mold, Flintshire, impts. in screw propelling apparatus.—*April 21st.*

1141. William Edward Gedge, of Wellington-street, impd. pessary,—a communication.—*April 24th.*

1232. Jean Baptiste Lavanchy, of Peter-street, Wardour-street, impd. chair ladder.

1238. Thomas Wright Roe, of Nottingham, impts. in machinery for folding and carding lace or light fabrics.

The above bear date May 3rd.

1315. Emile Cordonnier, of Paris, impts. in tents and stalls, and in the means of fixing them in the ground.—*May 12th.*

1340. George Ennis, of St. Heliers, Jersey, impts. in the construction of saw mills.

1341. William Deakin, of Great Barr, Staffordshire, and John Bagnall Johnson, of Tettenhall, near Wolverhampton, impts. in the manufacture of gun barrels and ordnance.

1342. Charles James Appleby, of Gracechurch-street, impts. in steam cranes.

1343. George Elliott, of Betley Hall, Staffordshire, and Samuel Bailey Coxon, of Usworth, Durham, impd. spring apparatus to be applied to the bearings of the axles of pulleys or drums used in collieries.

1344. Robert Harrild and Horton Harrild, of Farringdon-street, impts. in printing machines.

1345. Henry Besley, of Halberton, Devonshire, impd. corn, seed, and manure drill; parts of which invention are also applicable to other similar agricultural implements.

1346. John Dauglish, of Reading, impts. in ovens for baking bread.

1347. James Tangye, of Birmingham, impts. in machines for testing the strength of chains and cables, and for other like purposes.

1349. Henri Adrien Bonneville, of Paris, impts. in hydrometers for ascertaining the strength of spirits and the specific gravity of fluids,—a communication.

The above bear date May 15th.

1351. Walter Brown, of Bolton, impts. in machinery for manufacturing clog and patten soles.

1352. William Wright, of Mostyn, Flintshire, impts. in the treatment of the waste liquors obtained after treating burnt ores of copper, such impts. having for their object the production or extraction of cobalt and nickel.

1353. Moss Defries, of Houndsditch, impd. apparatus for facilitating communication by signals between different parts of a railway train.

1354. Henry Edwin Dixon, of Wolver-

hampton, impts. in letter clips or paper holders.

1355. Pierre Camille Lafont, of Pamiers, France, impts. in apparatus to be used with breech-loading fire-arms and ordnance.

1356. Richard Archibald Brooman, of Fleet-street, impts. in breech-loading fire-arms and in cartridges and bayonets for breech-loading arms,—a communication.

1357. Richard Leddicoat, of Gateshead, impts. in machinery for making rivets, bolts, spikes, and other similar articles.

1358. Walter Montgomerie, of Glasgow, impts. in locomotive engines.

1359. Svend Svendsen, of Great Suffolk-street, impts. in vessels or receptacles for containing oil and other liquids.

1360. James Worrall, of Ordsall, Lancashire, and Thomas Hughes, of Manchester, impts. in machinery or apparatus for stretching and drying textile fabrics; part or parts of which said apparatus are also applicable to other machines wherein fabrics are to be distended.

1361. George Walton, of Clapton, impts. in apparatus used in distilling hydro-carbons.

1362. André Chavanne, of Paris, mail-catching apparatus for bags or packages without stopping the express trains or others.

1363. Chauncey Orrin Crosby, of New Haven, U.S.A., impts. in machinery or apparatus for tapering, pointing, or reducing wires or rods for spindles, hatchel teeth, pins for dresses, and similar articles.

The above bear date May 16th.

1364. Fielding Fletcher, of Birmingham, impts. in water-closets.

1365. William Haigh, of Reddish, impts. in mechanism or apparatus for making and cutting cardboard.

The above bear date May 17th.

1367. Henry Rushton, of Northampton-road, Clerkenwell, the application of a certain kind of goat's hair in imitation of human hair to the manufacture of head dresses, moustaches, and all kinds of false hair, and the process of preparing the same.

1369. Christopher Smith Billups, of Chatteris, impd. apparatus for distributing liquid manure.

1370. William Richard Williams, of Northumberland-court, Charing-cross, impts. in dry gas meters.

1371. William Manwaring, of Banbury, impts. in reaping and mowing machines.

1372. Thomas Molden, John Newsome, and James Akeroyd, of Leeds, impts. in the furnaces of steam boilers.

1373. Richard Archibald Brooman, of Fleet-street, impd. method of securing corks or stoppers in bottles,—a communication.

1375. Richard Toomer Birt, of Otterbourne, near Winchester, impts. in traps used for catching rabbits and other animals.

1377. James Laing, of Dundee, impts. in sewing machines.

1378. William Eassie, of Gloucester, impts. in machinery for driving piles.

1379. Cyrus Copus, of Kennington-park-road, impts. in the construction of bedsteads.

The above bear date May 18th.

1380. Edward Augustus Raymond, of Brooklyn, New York, U.S.A., impt. in atmospheric forging hammers.

1381. George Henry Brooks, of Sheffield, impts. in sliding gas pendents or chandeliers.

1382. Samuel Ebrall, of Shrewsbury, impts. in breech-loading fire-arms.

1383. Thomas Marsden, of Pemberton, near Wigan, impts. in apparatus to be employed in spinning cotton and other fibrous materials.

1384. Henry de Mornay, of Westbourne-grove North, Bayswater, impts. in sewing machines.

1385. Thomas Richardson, of Newcastle-on-Tyne, and Martin Diederich Rücker, of Leadenhall-street, impts. in obtaining certain compounds of nitrogen and of sulphur.

1386. William Davey, of Hackney-wick, impts. in apparatus for washing or purifying coal gas, and for producing ammoniacal water therefrom.

1387. Alfred Vincent Newton, of Chancery-lane, impts. in the construction of screws and screw-drivers,—a communication.

1388. George Read, of Slinfold, Sussex, impts. in manumotive carriages.
1389. William Clark, of Chancery-lane, impts. in the ornamentation of fabrics and leather,—a communication.

The above bear date May 19th.

1390. Cornelius Varley, of Kentish Town-road, and Samuel Alfred Varley, of Roman-road, Holloway, impts. in telegraph supports, parts of the invention being applicable to other purposes.
1392. William Edward Newton, of Chancery-lane, impts. in apparatus for raising oil and other liquids from deep wells,—a communication.
1393. John Ambrose Coffey, of Gracechurch-street, impts. in distilling apparatus.
1394. John Martin, of North Shields, impts. in apparatus for steering ships, steam boats, and other sailing vessels.
1395. William Smith and George Browne Smith, of Kennington, impts. in wet gas meters.
1396. William Eddington, jun., of Chelmsford, impts. in apparatus for trenching and laying drain pipes for draining land.
1397. Edwin Attenborough, Samuel Mellor, and George Blackburn, of Nottingham, impts. in machinery or apparatus employed in circular knitting machines.

The above bear date May 20th.

1399. John Wylie and James Rew, of Glasgow, impts. in apparatus for the manufacture of 'impressed gold,' and similar paper hangings.
1401. David Powis and Henry Brittain, the younger, of Birmingham, impts. in the manufacture of wire gauze dish covers, plate covers, window blinds, fire guards, and meat safes.
1402. William Edward Gedge, of Wellington-street, impd. safety lock,—a communication.
1403. André Gustave Bigorie, of Paris, kind of casing, intended to protect the stock and lock of fire-arms with guiding caps to take aim.
1404. James Shand, of Upper Ground-street, impts. in fire engines.
1405. John Henry Johnson, of Lincoln's-inn-fields, impd. apparatus for freezing, iceing, and cooling liquids, —a communication.
1406. William Hodson, of Spilsby, Lincolnshire, impts. in locks,—a communication.
1407. James Moore Clements, of Birmingham, impts. in sewing machines.
1408. George Furness, of Great George-street, Westminster, and James Slater, of Catherine-terrace, Lansdowne-road, Lambeth, impts. in machinery applicable to the cutting off the upper parts of piles.
1409. Richard Müller, of Dartford, Arthur Thomas Weld, of Gravesend, and John Folliott Powell, of Albion-place, Hyde-park, impts. in the preparation of materials to be used as substitutes for animal charcoal.

The above bear date May 22nd.

1411. Edward Mc Nally, of Manchester, impts. in apparatus for cutting or forming screws, which is also applicable for cutting pipes or tubes.
1412. Henry Wilde, of Manchester, impts. in the production and application of electricity.
1413. Isaac Holt, William Holt, James Holt, and Joseph Maude, of Bolton, impts. in dyeing, and sizeing cotton, silk, woollen, and other yarns.
1415. Herman Adler, of Primrose-street, Bishopsgate-street, impts. in clocks and time-pieces.
1416. Henry Gibbs, of Hampstead-road, impt. in the manufacture of envelopes.

The above bear date May 23rd.

1417. Thomas Calvert and David Montgomery, of Annan, Dumfriesshire, impts. in looms for weaving.
1418. Henry Nunn, of Lower George-street, Chelsea, impd. mangle.
1419. Thompson Beanland, of Leeds, impts. in screw gills or hackle frames.
1420. John Dale and Alfred Paraf, of Manchester. impts. in calico and linen printing.
1421. Henri Adrien Bonneville, of Paris, impts. in hydraulic cranes,—a communication.
1422. Carl Theodor Möller, of Abbo, Finland, impts. in lamps,—a communication.

1423. George Ashcroft, of King William-street, city, impts. in presses used for pressing cotton, wool, hay, and fibrous materials.

The above bear date May 24th.

1424. John Ambrose Coffey, of Gracechurch-street, impts. in the retorts used in the manufacture of gas and in other distillations; which impts. are adaptable to evaporating vessels.
1425. John Ramsbottom, of Crewe, impts. in machinery employed in the manufacture of hoops and tyres.
1426. John Firth, of Sheffield, impts. in the manufacture of cast steel railway tires.
1427. David Welsh, of Glasgow, impts. in looms for weaving.
1428. Robert Maxwell, of Glasgow, impts. in applying coal-tar colors to cotton and linen.
1429. David Law and James Bennet, of Glasgow, impts. in apparatus for making cores and moulds for casting.
1430. Richard Archibald Brooman, of Fleet-street, impts. in machinery for separating or sorting fibres and filaments of different lengths, and forming them into a lap or fleece,—a communication.
1432. William Madders, of Manchester, impts. in ornamenting table cloths and other articles with embroidery.
1433. Edward Paton, of Perth, impts. in fire-arms.
1434. John Henry Johnson, of Lincoln's-inn-fields, impd. mode of making and venting cores and parts of moulds, to be used in the casting of iron or other metal,—a communication.
1435. John Gjers, of Middlesborough, impts. in ovens or kilns for the manufacture of coke.
1436. Thomas Wilson, of Birmingham, impts. in breech-loading fire-arms and ordnance, and in cartridges for breech-loading fire-arms.
1437. George Bray, of Leeds, impd. gas burner.
1438. Henry Gibbs, of Hampstead-road, impts. in the manufacture of artificial fuel, applicable chiefly to the kindling of fires.
1439. William Edward Newton, of Chancery-lane, impt. in the drawing and other rollers used in preparing and spinning cotton and other fibrous materials and textile manufactures,—a communication.
1441. Thomas Hallam Hoblyn, of Rickling, Essex, impd. compound spherical rest for ornamental turning lathes.
1442. Jeffery Eustace, of Luton, impd. composition to be employed in the manufacture of bonnets and hats.
1443. Michael Henry, of Fleet-street, impts. in treating fibrous materials and textile fabrics, and in producing soap,—a communication.

The above bear date May 25th.

1444. Charles Cotton, Francis Anderson, and Daniel Booker, of Nottingham, impd. plain or graduated gophering or puffing and pressing machine.
1445. William Clark, of Chancery-lane, impts. in knitting machines,—a communication.
1446. William Edward Gedge, of Wellington-street, impd. stay or corset busk,—a communication.
1447. Jean Alphonse Heinrich, of Mulhouse, system of rotative machines to be used as steam engines and water pumps.
1448. Richard Canham, of Clerkenwell, impts. in cupola and other blast furnaces.
1449. George Elliot, of Betley Hall, Staffordshire, and Robert Pattison Clark, of Newcastle-upon-Tyne, impd. machinery for loading and discharging cargo from ships and other vessels.
1450. Charles Benjamin Spaeth, of Philpot-lane, preparation for subduing and extinguishing fire,—a communication.
1451. Mylius Cohen, of Fenchurch-street, impts. in the construction of furnaces or fire-places,—a communication.

The above bear date May 26th.

1452. Charles Frazer, of Norwich, impts. in sawing machines.
1453. Scipion Sequelin, of Devonshire-street, Queen's-square, impts. in purifying animal and vegetable oils or fatty matters to be used for lubricating and other purposes.
1454. Leonard Brierly, of Birmingham,

impts. in ornamenting japanned surfaces, and in machinery or apparatus for that purpose.

1455. John Martin Rowan, of Glasgow, impts. in making cast-steel railway tyres, and in apparatus therefor.

1456. Richard Archibald Brooman, of Fleet-street, method of manufacturing oil from fatty matters or the residuum arising from the distillation of fatty matters, the manufacture of stearic acid soap, and purification of oils,—a communication.

1457. Richard Archibald Brooman, of Fleet-street, impts. in reproducing or producing copies of writings, drawings, music, and other characters, and in preparing originals to be transmitted by electric telegraph,—a communication.

1458. Richard Archibald Brooman, of Fleet-street, impts. in apparatus for measuring gas and other fluids,—a communication.

1459. Thomas Bourne, of Brixton, impts. in machinery for turning and finishing bodies of a spherical form, —a communication.

1460. Louis Moser, of Southampton, impts. in the manufacture of steel, and in furnaces used in such manufacture,—a communication.

1461. Thomas Bissell, of Tooley-street, impts. in breech-loading fire-arms and in sights for rifles.

1462. Ludwig Diele, of Hackney-road, impts. in mechanism for locking or fastening tiers or sets of drawers arranged in writing tables, cabinets, chests, or other articles of furniture.

The above bear date May 27th.

1464. Jean Alphonse Heinrich, of Mulhouse, France, impd. machine for washing raw materials, worked out or unworked, to be employed in the manufacture of fabrics, and specially of fabrics made into pieces.

1465. Henry Tipper, of Feltham, Middlesex, and of Melbourne, Victoria, impd. kind of shirt.

1466. William Settle, of Camden-town, impd. bottle stopper,—a communication.

1467. Peter Armand le Comte de Fontainemoreau, of Paris, impts. in the manufacture of lime,—a communication.

1468. Henry Moseley, of Olveston, Gloucester, impd. machine for obtaining motive power, and other useful purposes.

1469. Peter Young, of Manchester, impts. in the construction of furnaces.

1470. Henri Son, of Shepherd's-court, Upper Brook-street, impts. in the construction of keyless watches.

1471. Edward Myers, of Millbank-row, Westminster, and James Stodart, of Cambridge-terrace, Notting-hill, impts. in the means and apparatus employed for preventing downward draught in chimneys, facilitating the escape of smoke therefrom, and for ventilating apartments or buildings.

1472. William Johnson, of Sowerby Bridge, Yorkshire, impts. in vices.

1473. Frederick Arthur Paget, of Adam-street, Adelphi, impts. in locking screws and the nuts of bolts, as also in preventing an unequal straining of their threads.

1474. Charles Henry Murray, of Loman-street, Southwark, impd. machinery or apparatus for cutting off wooden piles below water.

1475. William Tighe Hamilton, of Dublin, impts. in circular saws commonly called drunken saws.

The above bear date May 29th.

1476. Samuel Davis, of The Strand, impd. dog leash or slip.

1477. William Smith, of Bernard Castle, Durham, impd. road scraper.

1478. William Hubert Stanley, of Chipping Campden, Gloucestershire, impts. in wickets for the game of cricket.

1479. James Hare the younger, of the Lozels, near Birmingham, impts. in instruments or apparatus for cleaning the interior of tubes or hollow cylinders, gas chimneys, and other hollow articles.

1480. John Hibell, of Nechells, near Birmingham, impts. in annealing pots and saucers, for annealing iron and steel wire, sheet metal, and other articles.

1481. Jonathan Jopling, of Bishopwearmouth, impts. in apparatus for propelling and steering vessels.

1482. William Martin, of Manchester, impts. in brooms or brushes.
1483. Moritz Meisel, of Gloucester-terrace, Old Brompton, impts. in spinning machinery,—a communication.
1484. Benjamin Lawrence, of Coleman-street, impt. in inkstands,—a communication.

The above bear date May 30th.

1485. Sidney Grafton, of Birmingham, impts. in the keys of locks having through holes.
1486. Robert Hanham Collyer, of Brompton, impts. in the process and apparatus for the treatment of materials for the manufacture of paper and other purposes.
1487. John Calvert, of the Strand, impts. in the construction of locks.
1488. Luke Martin, of Blackburn, impd. method of, and apparatus for, moulding wheels.

The above bear date May 30th.

1489. Thomas Spencer, of Euston-square, impts. in the composition and manufacture of paints applicable to iron and other ships' bottoms, and for other general purposes.
1490. Thomas Appleton Browne and John Knight, of Altrincham, Cheshire, impts. in driving apparatus for hair brushing and shampooing by machinery.
1491. Peter Pilkington, of Accrington, impts. in steam hammers, partly applicable to steam engines.
1493. Isaac Rogers, of Oregon-terrace, Peckham-rye, impts. in means or apparatus for signalling on railway trains, and effecting communication between passengers and guards, or others in charge of such trains.
1495. Frederick Hazeldine, of Lant-street, Borough, impts. in the construction of vans, waggons, or carts employed for transporting furniture and other goods on common roads and railways.
1496. William Augustus Brown, of Newcastle-upon-Tyne, impd. mechanical arrangements for steering ships and other navigable vessels.
1498. Thomas Summerson, of Darlington, impts. in foundry cupolas.
1499. William Edward Newton, of Chancery-lane, impts. in the manufacture of carpets and other terry and cut-pile fabrics,—a communication.
1500. John Petrie, jun., of Rochdale, impts. in machinery or apparatus for washing wool and other fibrous materials.

The above bear date May 31st.

1501. Francis Richmond, Henry Chandler, and James Gadsby Richmond, all of Salford, impts. in machines for cutting hay, straw, and other vegetable substances.
1502. Henry Martin, of Leicester, impts. in apparatus for signalling on railway trains, and for effecting communication between parts of such trains.
1503. William James Burgess, of Brentwood, impts. in reaping and mowing machines.
1504. David Hancock and Frederick Barnes, of High Wycombe, impd. method of obtaining motive power, together with certain machinery or apparatus for applying the same.
1505. Herbert Allman, of Ampthill-square, impts. in the formation and construction of metallic vessels, chambers, or hollow cylinders used in hydraulic apparatus, cannon, or heavy guns, and for like purposes.
1506. Herbert Allman, of Ampthill-square, impts. in the manufacture of iron and steel, and in apparatus connected therewith.
1507. William Clark, of Chancery-lane, impts. in the means of carburetting or treating aëriform fluids for lighting and heating purposes, and in apparatus for the same,—a communication.
1508. Thomas Brinsmead, of St. Giles in the Wood, near Torrington, impd. exercising chair for infants.
1510. Frederick Knight, of Burton-upon-Trent, impd. economic boiler for hot water apparatus, applicable for the heating of hot houses, churches, and other public buildings.
1511. Thomas Hunt, of Preston, Lancashire, impts. in the construction of the permanent way of railways.
1512. Henry Mallet, of Nottingham, impts. in the manufacture of lace in twist lace machines.
1513. William Edward Newton, of

Chancery-lane, impd. pocket lantern,—a communication.

1514. William Edward Newton, of Chancery-lane, impd. machinery for raising the pile of woven or other fabrics,—a communication.

The above bear date June 1st.

1515. Herbert Allman, of Ampthill-square, Middlesex, impts. in the means employed for the prevention of the ignition of matter capable of ignition or combustion.

1516. John Nuttall, of Patricroft, near Manchester, impts. in valves for steam and other fluids and liquids.

1517. Thomas Pritchard, of Wednesbury, impts. in furnaces used in the manufacture of welded iron tubes.

1518. Richard Archibald Brooman, of Fleet-street, impts. in electro-magnetic clocks and other time-keepers,—a communication.

1519. William Gadd, of Nottingham, and John Moore, of Manchester, impts. in the manufacture of pile fabrics.

1520. George Kent, of High Holborn, and William Hayward West, of Orange-street, Red Lion-square, impts. in apparatus used when boiling milk.

1521. Henry Edward Newton, of Chancery-lane, impts. in steam boilers,—a communication.

1522. Francis John Bolton, of Bruton-street, Middlesex, and Henry Matheson, of Hackney, impd. process for producing printing surfaces.

1523. James Shepherd, of Whitefield, Lancashire, impts. in safety apparatus for steam boilers.

The above bear date June 2nd.

1525. Alfred Lancaster, of Kensington-road, impts. in breech-loading fire-arms.

1527. Charles Taylor, of Birmingham, impts. in tube cutters and screw stocks.

The above bear date June 3rd.

1528. Edward Eastman, of Central-steet, St. Luke's, impts. in apparatus for measuring the human figure for garments.

1529. John Stephenson, of Marylebone, impts. in umbrellas, parasols, and sunshades.

1530. William Townend, of Bradford, Yorkshire, impts. in apparatus for doubling and twisting yarns and threads.

1532. Charles de Bergue, of the Strand, impts. in machinery or apparatus for bending and straightening angle iron, T iron, and other iron bars.

1534. Thomas Gentle and Joseph Allmark, of Oldham, impts. in turbines.

1535. Philip Coombes, of Liverpool, impd. apparatus for separating the whey from the curd in the manufacture of cheese.

1536. Alfred Johnson Aspinall, of Tuebrook, near Liverpool, impd. hand stamp for printing letters, numerals, and other figures.

1538. John Robertson, of Glasgow, impts. in the machinery or apparatus for actuating the slide valves of marine engines and in the slide valves thereof.

1539. John Henry Johnson, of Lincoln's-inn-fields, impts. in corks or bungs, for closing bottles and other receptacles for liquids,—a communication.

1540. Richard Archibald Brooman, of Fleet-street, impts. in the manufacture of soap, and in apparatus employed therein,—a communication.

1541. William Edward Newton, of Chancery-lane, impd. photo-electrotyping process,—a communication.

1542. Frederick Tolhausen, of Paris, impd. break applicable to various descriptions of steam engines, and also to railway purposes,—a communication.

1543. Alice Isabel Lucan Gordon, of Prince's-gate, Hyde-park, impd. system of telegraphic communication on railways; parts of which invention are also applicable to other telegraphic purposes.

1544. James Kennedy, of Elgin-road, Notting-hill, impd. method of submerging telegraphic cables.

1545. Charles Howard Wansbrough, of Shrewton, Wilts, impts. in the treatment of condensing pans employed in the condensation of milk,—a communication.

The above bear date June 5th

1546. George Haseltine, of Southampton-buildings, impts. in breech-loading fire-arms, and in metallic car-

tridge cases for the same,—a communication.

1547. David Barker, of Ceylon-street, Battersea-park, impts. in the manufacture of artificial fuel.

1548. Henry Hermann Kromschroeder and John Frederick Gustav Kromschroeder, of Church-road, Haverstock-hill, impts. in dry gas meters.

1549. Richard Archibald Brooman, of Fleet-street, impts. in the construction of reservoirs for containing and storing petroleum and other oils,—a communication.

1550. Richard Archibald Brooman, of Fleet-street, impts. in machinery for combing wool and other filamentous and textile materials,—a communication.

1551. Alfred Pemberton and Alfred William Pemberton, of Eccles, impts. in machinery or apparatus for spinning, doubling, or twisting cotton and other fibrous materials.

The above bear date June 6th.

1553. Jas. Howarth, of Andover, impd. method and apparatus for distilling coal, shale, and other carbonaceous substances,—a communication.

1554. Arthur Charles Henderson, of Charing-cross, impts. in tanning hides, and in apparatus connected therewith,—a communication.

1556. Frederick Foster, of High-street, Whitechapel, impts. in oil and other liquid feeders.

1557. William Tongue, of Wakefield, Yorkshire, impts. in machinery for combing and heckling fibrous materials.

1558. Thomas Smith, of Birmingham, impts. in the manufacture of axes, adzes, picks, and other like tools having a hole or eye formed in them for receiving a handle.

1559. William Sim and Arthur Barff, both of Glasgow, impd. method of generating heat, and apparatus or means for effecting the same.

1560. John Ferguson and Robert Miller, both of Glasgow, impts. in the manufacture of steel.

1561. William Edward Newton, of Chancery-lane, impts. in steam engine governors,—a communication.

The above bear date June 7th.

1562. Joseph Rock Cooper, of Birmingham, impts. in central-fire breech-loading firearms.

1563. Samuel Blatchford Tucker, of Threadneedle-street, impts. in caloric or heated air engines,—a communication.

1564. Henry Hunt, of Lewisham, and Richard Hunter, of Tottenham-court-road, impts. in the manufacture of frames for looking-glasses.

1565. Samuel Stell, Thomas Broughton, and Francis Hall, of Keighley, impts. in apparatus employed in preparing and spinning wool, silk, flax, and other fibrous substances.

1566. Jabez Draper, of De Beauvoir-road, Kingsland, impt. in sewing machines; which improvement is also applicable to other machines driven by a strap or band.

1569. James Holmes, George Thomas Holmes, and Frederick Robert Holmes, of Norwich, impts. in horse-hoes and drills.

1567. Barnet Solomon Cohen, of Magdalen-row, Goodman's-fields, impts. in sheathing or coating the bottoms of ships or vessels.

The above bear date June 8th.

1570. Howard Busby Fox, of Oxton, Cheshire, impts. in the construction of the necks of bottles and other vessels, and in means for closing or covering the mouths of such bottles or vessels.

1571. William Wilson Hulse, of Manchester, impts. in machinery or tools for cutting metals or other materials.

1573. William Edward Gedge, of Wellington-street, impd. process for penetrating or impregnating woods with various substances,—a communication.

1574. Julius de Hemptinne, of Ghent, impts. in the spinning of cotton and other fibrous materials.

1575. Charles Vernon and William Hodgkins, of West Bromwich, impts. in safety valves; which improvements are also applicable to steam engine and other valves.

1576. Lieut.-Colonel James Baker, of Cambridge, impts. in machinery for obtaining power when fluid pressure is employed.

1577. William Horatio Harfield, of Royal Exchange-buildings, London, impts. in apparatus for steering ships and vessels.

1578. George Edward Meek, of Crane-court, Fleet-street, and William Howes Howes, of Curtain-road, Shoreditch, impts. in fastenings for doors, windows, drawers, and other like purposes.

The above bear date June 9th.

1579. Joseph Mayer Dentith, of Connah's Quay, Flintshire, impts. in the manufacture and production of chromate and bichromate of potash, employed in dyeing and printing woven fabrics.

1580. John Henderson, of Bradford, Yorkshire, impts. in apparatus for printing wool, worsted, or other fibrous materials.

1581. Arthur Hamilton Gilmore, of Bursledon, Hants, impd. means or apparatus to be applied to doors and windows for the purpose of supporting or maintaining them in any required position when open, and in securing them when shut.

1582. Richard Archibald Brooman, of Fleet-street, impts. in kilns for firing porcelain and other ware,—a communication.

1583. Daniel Spink, of Weston-super-Mare, impts. in propelling vessels.

The above bear date June 10th.

1584. John Glazebrook, Mark Nield Mills, and Benjamin Riley Mills, all of Ashton-under-Lyne, impts. in sewing machines.

1586. John Edgar Poynter, of Glasgow, impts. in purifying paraffine.

1587. George Haseltine, of Southampton-buildings, impd. method of, and machinery for, cutting and excavating rock for railway tunnels and other purposes,—a communication.

1589. George Speight, of Collingwood-street, City-road, impd. machine for curling or curving collars and cuffs.

1590. Richard Archibald Brooman, of Fleet-street, impts. in furnaces,—a communication.

1591. John Thomas, of Battersea, material to be used in the purification of heating and lighting gases.

1592. James Hayes, of Bow-lane, London, impd. construction of sewing machine.

The above bear date June 12th.

1594. Albert Robinson, of Great George-street, impts. in the means and apparatus for firing and curing tea,—a communication.

1595. George Haseltine, of Southampton-buildings, impts. in fuses for shells for ordnance,—a communication.

1596. Jonathan Alonzo Millington, of Maidstone, and Alfred Allnut, of Loose, near Maidstone, impts. in machinery employed in and for the manufacture of paper.

1597. Charles Alfred Hemingway, of Dewsbury, impd. cased splint for fractures.

1598. John James Bodmer, of Newport, Monmouth, impts. in the method of constructing partitions, walls, floors, and roofs of buildings.

1600. Charles James Collins, of Upper Thames-street, impd. artificial fuel.

1601. John Henry Johnson, of Lincoln's-inn-fields, impts. in wheels for locomotive engines, railway carriages, and other purposes,—a communication.

1602. Thomas Routledge, of Ford, near Sunderland, and William Henry Richardson, of Springwell, Jarrow-on-Tyne, impts. in the manufacture of paper and paper stock, and in the utilization of certain waste products resulting therefrom.

1603. Edward Samuel Horridge, of Cheltenham, impts. in communicating signals in railway trains.

1604. James Griffiths, of Ludlow, Shropshire, impd. self-acting break for four-wheeled carriages.

1605. François Alexandre Laurent and John Casthelaz, of Paris, impts. in the manufacture of phthalic acid and chloroxynapthalic acid, and in dyeing and printing.

The above bear date June 13th.

1606. Henry George Fairburn, of St. Luke's, impd. machinery for compressing and solidifying coal and other analogous substances.

1607. Benjamin Massey and Stephen Massey, of Openshaw, near Manchester, impts. in hammers and other

machines actuated by steam or other fluid or vapour.

1608. Charles de Vendeuvre, of Vendeuvre Jort, Calvados, France, impd. apparatus for the purpose of stopping and easing strains on ships' cables when in use.

1609. Andrew Edmund Brae, of Leeds, impd. means of conducting electric currents through railway trains, and of actuating signals or alarums therein.

1610. William Edson, of Boston, U.S.A., impt. in apparatus for indicating the hygrometric condition of the atmosphere.

1611. George Edward Keats, of Leicester, and John Keats, of Street, Somersetshire, impts. in sewing machines.

1612. William Robinson Mulley, of Plymouth, impts. in sheathing iron ships.

1613. Sidney Courtauld, of Waddon, Surrey, and Charles Wilkins Atkinson, of Saint George's, Bloomsbury, impd. arrangements for opening and shutting carriage windows.

1614. Henry Ormson, of Chelsea, impts. in multitubular hot-water boilers.

The above bear date June 14th.

1615. Stanislaus Helcman, of Ryder's-court, Leicester-square, impd. arrangement for fastening shirts, collars, and other articles of wearing apparel, by which the ordinary button or stud is dispensed with.

1616. Stanislaus Helcman, of Ryder's-court, Leicester-square, impd. description of stud for fastening shirts, cuffs, waistcoats, and other articles of wearing apparel.

1617. Jules François Dubois, of Paris, impd. bit for subduing or stopping runaway or restive horses.

1620. Richard Archibald Brooman, of Fleet-street, impts. in furnaces,—a communication.

1621. William Clark, of Chancery-lane, impts. in apparatus for preventing collisions and other accidents on railways,—a communication.

1625. John Hartley, of Otley, Yorkshire, impts. in corn screens.

1626. Henri Adrien Bonneville, of Paris, impts. in apparatus for facilitating the traction of public and other vehicles,—a communication.

The above bear date June 15th.

1627. William Edward Gedge, of Wellington-street, impd. method of, and apparatus for, manufacturing pottery,—a communication.

1628. Michael Henry, of Fleet-street, impts. in the method of, and apparatus for, effecting and recording telegraphic communications,—a communication.

1629. Richard Archibald Brooman, of Fleet-street, impts. in the manufacture or shaping of iron intended for the shoes of horses and other animals, and in machinery employed therein,—a communication.

1630. Richard Archibald Brooman, of Fleet-street, impts. in watches and other time-keepers,—a communication.

1631. John Henry Johnson, of Lincoln's-inn-fields, impts. in lamp burners and parts connected therewith,—a communication.

1632. Charles Augustus Lamont, of New York, U.S.A., an impd. mode of desiccating eggs, and apparatus for effecting the same.

1633. William Trevor Wanklyn, of Manchester, impts. in silk-winding machines; part of the said improvements being also applicable to cleaning and doubling machines.

The above bear date June 16th.

1635. Henry Everard Clifton, of Liverpool, impts. in apparatus for 'lap' and 'surface shaving,' the splitting and bevelling of leather, and other like substances, in sheets and strips.

1636. August Klein, of Leipzig, impts. in gunpowder for mining and war purposes,—a communication.

1637. Walter Howes and William Burley, of Birmingham, impts. in lamps for railway and other carriages, and in connecting lamps to carriages; a part of which impts. may also be applied to handles for carriages.

1638. George Payne, of Belmont Works, Battersea, impts. in purifying cotton and in the apparatus to be employed therefor.

1639. Thomas Russell Crampton, of Great George-street, impts. in the

construction of roadways, floorings, or other surfaces.

The above bear date June 17th.

1643. Henry Defries, of Houndsditch, enabling the guards of railway trains to pass from one part of a railway train to another.

1644. Edward Whalley, of Blackburn, impts. in machinery for twisting, doubling, and laying all kinds of yarns.

1646. George Smith, the younger, of Richmond-terrace, Clapham-road, impts. in locomotive engines and railway carriages.

1647. John Henry Johnson, of Lincoln's-inn-fields, impd. preparations for the treatment and preservation of the hair,—a communication.

1648. William Clay, of Liverpool, impts. in ventilating railway carriages.

The above bear date June 19th.

1649. Philippe Mingand, of Nismes, France, impts. in obtaining jellies, syrups, drinks, and other products from the tree *Arbutus unedo*, known as the Arbutus.

1650. George Clark, of Napier-street, Borough, impts. in envelopes or wrappers for covering, packing, and protecting bottles, jars, or other fragile articles, and in apparatus for manufacturing the same.

1651. Abraham Colley, of Enfield-highway, impts. applicable to breech-loading fire-arms.

1652. William Edward Gedge, of Wellington-street, impd. elastic mattress or spring bed,—a communication.

1655. Edward Griffith Brewer, of Chancery-lane, impts. in the construction of taps or valves,—a communication.

The above bear date June 20th.

New Patents Sealed.

1864.

3090. G. W. Otway.
3167. C. E. Bryant and S. Middleton.
3177. Robert Wilson.
3179. J. Fothergill and J. H. Fothergill.
3185. James Gillespie.
3186. J. B. Edge and E. Hird.
3193. J. F. Wheeler.
3195. R. A. Brooman.
3198. The Honorable John Hay.
3207. Edmund Morewood.
3208. C. H. Taylor.
3211. J. P. Robertson.
3214. H. Hicklin and C. Pardoe.
3216. George Alton.
3217. George Alton.
3221. John Cleaver.
3222. J. R. Breckon and R. Dixon.
3232. James Millar.
3233. M. A. Muir and J. McIlwham.
3236. T. R. Harding.
3237. John Dodd.
3239. W. Nalder and A. Belcher.
3242. Benjamin Baugh.
3244. Elbert Perce.
3248. H. A. Bonneville.
3251. W. H. Brown.
3253. Joseph Ladley.
3255. P. A. Roger.
3256. Thomas Richardson.
3258. Richard Quin.
3259. Thomas du Boulay.

1865.

3. M. R. Leverson.
4. E. Bevan and A. Fleming.
6. J. Smith and J. Williamson.
7. J. Spencer and N. Broomhead.
9. Robert Irvine.
14. Henry Lloyd.
15. Leopold D'Aubreville.
16. T. J. Ashton.
17. Louis Goldberg.
18. G. Hodgson and J. Pitt.
23. Wilson Ager.
24. Dionisio Veriochio.
26. George Kent.
27. Nathan Thompson.
28. W. H. Roy.
29. William Watson.
32. J. W. Branford.
33. J. M. Kirby.
34. Joseph Skelton.
38. G. A. Buchholz.
39. Thomas Pickford.
40. J. E. Vigoulet.
42. Jules Lebaudy.
47. W. C. Thurgar.
48. Charles De Bergue.
50. T. Richardson and M. D. Rücker.

53. George Raymond.
55. G. B. Galloway.
56. B. W. Bentley and W. H. Bailey.
60. J. J. Blackham.
61. Theophilus Horrex.
63. Ashworth Barlow.
64. J. H. Johnson.
68. Wm. Davies.
70. B. P. Bidder.
71. Friedrich Wiese.
73. J. S Brown.
74. J. C. Brown.
78. A. and M. Meyer.
80. William Clark.
83. Henry Contanche.
84. A. F. Lendy.
85. W. E. Gedge.
86. W. E. Gedge.
88. R. A. Brooman.
90. Robert Tempest.
99. E. T. Hughes.
100. Wm. Russ.
101. F. Barnes, D. Hancock, and E. Cowpe.
102. R. A. Brooman.
104. Geo. Gaze.
106. G. H. Daw.
110. W. S. Longridge and J. Mash.
111. Wm. Brookes.
112. A. J. Sax.
114. J. Weeks.
115. Wm. Wilson.
117. Wm. Wilkins.
118. A. and E. Paul.
119. George Davies.
125. Theodore Bourne.
129. F. C. Fourgeau.
130. J. B. Farrar and J. Hirst.
134. Jno. Marshall.
137. Joseph Betteley.
138. G. F. Bousfield.
139. J. S. Edge.
140. R. A. Brooman.
141. F. H. Lakin.
143. J. Robinson and J Smith.
144. C. T. Judkins.
146. F. P. H. Cahuzac.
147. William Jeffreys.
149. Edward Deane.
150. Stephen Ballard.
151. J. W. Gregg.
153. Joseph Burch.
154. J. Coulter and H. Harpin.
159. A. W. Preger.
160. M. B. Mason.
161. E. D. Farcot.
163. G. F. Bradbury.
166. W. C. Hicks.
174. Louis Balma.
176. B. F. Stevens.
177. Wm. Clark.
189. Matthew Robinson.
199. Thos. Brown.
214. Casimir Roques.
216. Otto Gössell.
224 Robert Mushet.
225. John Harrison.
230. Chas. Falck.
231. William Creasy.
232. George Dibley.
234. William Clark.
236. C. D. Abel.
239. J. and H. Southall.
241. John Combe.
247. S. Trulock, R. Trulock, and W. Trulock.
263. F. A. Laurent and J. Casthelaz.
311. F. C. Hills.
314. Wm. Clark.
318. Robert Richardson.
320. W. E. Newton.
328. E. and T. Williams.
329. Wm. Cockburn.
334. William Sim.
348. W. E. Newton.
406. F. C. Vannet.
409. W. E. Newton.
410. James Gresham.
413. George Harton.
446. C. O. Staunton.
447. W. E. Newton.
483. J. H. Johnson.
486. W. E. Newton.
535. James Starley.
655. W. T. Hamilton.
769. S. S. Gray.
771. J. T. Romminger.
775. A. G. Browning.
790. R. J. Gatling.
831. T. Farmer and F. Lewis.
977. C. H. Williams.
982. J. G. Jones.
958. G. T. Bousfield.
992. Thos. Wilkes.
996. W., E., and J. Gray.
1060. Jas. Rippon.
1024. Stephen Wright.
1052. Herman Leonhardt.
1067. C. R. Fisher.
1092. G. T. Bousfield.
1107. Henry Caudwell.
1117. W. Scarratt and W. Dean
1165. C. W. Heaven.
1192. Julian Bernard.
1256. Edward Richardson.
1263. Solomon Bennett.
1271. Wm. Clark.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S
London Journal of Arts and Sciences.

No. CXXIX. (NEW SERIES), September 1st, 1865.

OUR PARTNERSHIP LAWS.

Coleridge has said, that "without trade and literature, mutually commingled, there can be no nation; without commerce and science no bond of nations." History proves the truth of this aphorism; and the experience of the present age has further confirmed it; yet how little have the rulers of nations acknowledged its truth by their acts —by encouraging trade and literature, commerce, and science. In some respects Great Britain has taken the lead, and in others followed far in the rear, of other nations, in the encouragement held out to the fabricators of these bonds of union among individuals and peoples. So far as our laws are concerned, the follower of literature has had little to complain of since the passing of the Copyright Act of 1842, for the profits of his labours (should any arise) are secured to him and his family for a lengthened period. Moreover, the "liberty of the press," which has long been conceded, leaves the British author free and unfettered, both in the choice of his subject and of its treatment. Again, for the followers of practical science the patent law has done much; and, if properly administered, would do all that is needed, and in this respect we are on a level with the most forward nation. But for those pioneers who devote themselves to the investigation of pure or unapplied science, the law has yet done nothing, and we might learn on this head much from the practice of our neighbours.

As respects commerce, its shackles were loosened by the expiration of the East India Company's Trading Charter, and by a long course of legislation, commencing with the repeal, in the year 1843, of the law prohibiting the export of machinery. This was followed up by the repeal, in 1846, of the Corn Laws, and by the subsequent abolition

of the Navigation Laws, and the various modifications introduced into the tariff on imported goods; by which the principle of free trade has, for all practical purposes, become established.

In respect of the development of the principle embodied in this important branch of political economy, we are in advance of all the nations; but there is one other phase of the principle of little less importance to a commercial community, which, after long refusing to recognise, we have been content to import into our laws little by little, until at last something like freedom of action is left to the owners of capital. It is singular that in a country like Great Britain, in which the carrying out of public improvements is almost wholly dependent on private enterprise, that the laws should have been so hostile as they were, till recently, to combinations of capital. These laws, it is true, were constantly set aside by means of special Acts of Parliament, but frequently the money expended in obtaining legislative recognition of a project would have sufficed to carry it into execution. Not merely were our railways originated, expanded, and modified under special Acts, but the same power had to be evoked for the formation of canals, water works, gas works, piers, and, in short, all public undertakings, whether the funds were provided from public or private sources. Again, whenever trading companies were established, whether for banking, or assurance, or general commerce, the liability of the individual shareholder to make good all losses, to the full extent of his means (and altogether irrespective of his holding in the company), was insisted on by law, to the destruction, in many cases, of the first principles of equity. So jealously, indeed, were combinations of interests guarded against, that up to the passing of the Patent Law of 1852, there was an express proviso in every grant that letters patent shall not become vested in, or be held in trust for, more than the number of twelve persons. This strange proviso was necessarily set aside by the Legislature on the incorporation of companies for working certain patents; but so confirmed was the custom of insisting on this limitation, that it required a special clause in the Act of 1852 to enable more than twelve persons to hold a legal and beneficial interest in any patent.

The passing of the Act for limiting the liability of members in joint-stock companies, in the year 1855, was the first legal recognition of the principle of free trade as applied to the employment of capital. The dread—which we must acknowledge was very general—of corporate bodies so controlling circumstances as to become an incubus on struggling industry or single-handed competition, slowly died out under the experience of the numberless companies incorporated under Acts of Parliament; and the facilities which the laws of France and

America afforded of shielding companies, consisting practically of English capitalists, by locating their head office in Paris or New York, showed the absurdity of holding out longer against the wishes of the mercantile community. This Act of 1855 is, we doubt not, destined to do much for the development of British enterprise; but it requires time to educate a class who, without individually possessing capital, shall feel the responsibilities which attend on its expenditure. It was only to be expected at first that "clever fellows" would find in the Limited Liability Act a new field for the application of their peculiar abilities; and we have seen some bright examples of their doings: but in time the management of joint-stock manufacturing and trading societies will be looked forward to as the sure reward of well-conducted men, who have to look for success in life solely to their own unaided exertions.

Although the working of the principle of limited liability during the last ten years cannot be pronounced, for the cause assigned above, as unequivocally successful, yet it has proved that the principle itself is right; and it has induced the legislature to give the mercantile public a further instalment of free trade in capital. By the Act of last session for the amendment of the partnership law, money may, for the first time, be advanced, on the condition of receiving a share in the profits of a business, without the lender being liable for the debts contracted by the ostensible owner of the business. So, also, the principle which French manufacturers applied for their own protection during the revolution of 1848—viz., the sharing of profits with their servants—may now be adopted here without those servants becoming actual partners. A third provision, which enables annuitants of a deceased partner, and also recipients of profits, in consideration of the sale of the goodwill of a business, to receive their payments without being saddled with the responsibilities of a partnership is calculated to produce the most beneficial results; for how few businesses are there that will fetch in the market a round sum at all equivalent to the profits which they produce? and yet, before this Act, they had to be disposed of absolutely, and the capital embarked therein withdrawn, on the death or retirement of their owners, in order that no mishap of the successor should be visited on the former proprietor or his family. Another, and perhaps a more important, advantage which the new law is calculated to confer is, we think, increased profits at moderate risks for capital in the hands of persons of limited income, who have hitherto been compelled to resort to such unlucrative investments as the three per cent. consols or the four per cent. debentures of railway companies. When persons of this class become investors in trades, we shall soon cease to hear of "shopocracy" and other disparaging terms whereby attempts are made in small coteries to define and isolate classes; and although we shall become more than

ever a "nation of shopkeepers," we shall, at least, acquire a practical knowledge of the value of the working bees, by whose untiring exertions the power of the nation is being continually extended, and its wealth and comforts increased.

THE ATLANTIC CABLE ENTERPRISE.

Upon no engineering effort of this, or perhaps any other age, has so much of public attention been rivetted as upon the recent attempt to bring Europe and America into telegraphic communication by the submarine cable, which of itself constituted a sufficient cargo for the largest vessel that ever combated the waves. Full of hope and confidence, the expedition sailed, and the commencement of the paying out was impatiently awaited. From the time the shore end was laid and spliced to the main line, the progress of the operation was watched by the whole country, and the daily utterances of the cable itself were as earnestly looked for as if they had been so many sybilline verses. For awhile these utterances were clear and satisfactory; then they faltered and ceased. At this state of affairs the public was good enough to express anxiety, which was quickly converted into delight at the resumption of intelligible signals. This continued for a time, and then again ceased. A third time hopes were raised that the aspirations of the public would be realized by the re-establishment of telegraphic communication; and then again the insulation of the cable was destroyed. In the absence of information as to the cause of the apparent failure, the curiosity of the public was kept alive by assurances of still possible success; but in due course the "Great Eastern" returned, and gave to the world a record of the mishap. The complacency with which this account has been received is remarkable. Not a breath of disappointment is discernible, and the praises of the entire press have been lavished upon all concerned. We are congratulated on the acquisition of scientific facts which the expedition has brought to our knowledge, and are assured that such valuable experiences as this and the preceding experiments have afforded will certainly render the laying of ocean telegraphic wires a very simple operation. But what of the shareholders, at whose expense we have gained such valuable facts and experiences? They are simply bade to take courage, for has not that monster of the deep proved to be invaluable as a cable layer; and are not the errors of omission with respect to the hauling-in apparatus easily remediable? The truth is, that this will prove but another of the many examples which might be

cited of the nation appropriating what has been acquired by private purchase.

The experience respecting the practical value of atmospheric railway propulsion was acquired at the sacrifice of private capital. So also was the science of tubular bridge building; and with regard to the "Great Eastern" itself, the *Times*, as the leader of public opinion, in the year 1861, offered the following consoling remarks to those by whose capital that great experiment in naval architecture was conducted:—"To the proprietors we can administer no other comfort than what we have had to give before. They are trying a grand experiment, and are the world's benefactors, but must expect to lose. In thirty years, however, we shall see a dozen 'Great Easterns,' which will have profited by the disasters of the first."

The same kind of comfort is doubtless in store for the Telegraph Construction and Maintenance Company (Limited); but whenever that company shall, by its enterprise, have established a flourishing business, rivals will enter the field; and whatever steps it may take to hold its own, will be denounced as evidences of a grasping and tyranous spirit. But let us not anticipate, for before then the world may become wiser, and consequently more just.

Costly as the failure to link together the great continents of Europe and America has proved, the company does not appear to have lost heart; and certainly it is encouraged on all sides, by men most conversant with this novel branch of engineering, to persevere. Whether the directors are satisfied with the skill displayed by their staff has not been disclosed, but as respects the naval and electrical knowledge on board, it is pretty evident there was little more to desire. When, however, the recovery of the severed cable was attempted, it does not appear that the success of the naval men in grappling the cable—a work, all things considered, of admirable seamanship—was properly followed up. We are inclined to the opinion of Mr. F. C. Webb, as expressed in his letter to the *Times*, August 21, that "the strain which eventually broke the grapnel ropes was in great part due to the catenarian strain, caused by the cable not being sufficiently slack," and that "if slack ropes had been laid, attached to the moorings of buoys, the cable could have been raised at the last buoy with no greater strain than that required to lift the weight of the two lengths of cable hanging vertically to the bottom, or, in fact, about three tons." This opinion is to some extent confirmed by Mr. Thompson, C.E., in a letter published in the *Times*, on the 26th of August; and a subsequent letter of Captain J. R. Ward, wherein he suggests the use of a cutting grapnel, also implies that it was not merely the weight, but the drag, of the cable that the grapnels unsuc-

cessfully contended against. But in a work of such novelty as the recovery of a cable sunk at a depth of 2000 fathoms it is not to be supposed that the most skilful engineers would be prepared for all emergencies.

The opinion is now evidently inclining to the abandonment of a metallic covering for marine telegraphic cables, and to reliance solely on their internal strength. We shall be surprised if the next attempt to connect the two continents electrically does not include the use of such a cable as was laid by Messrs. Newall in the Black Sea during the Crimean war. The cost of manufacture will not be a tithe of that lately coiled so hopefully in the holds of the "Great Eastern," and the risks of laying will be greatly lessened. Whatever may be the result of the next experiment, we think the shareholders in the Telegraph Construction and Maintenance Company will have entitled themselves to the thanks of the country, and we trust that their public spirit will receive due acknowledgement.

Recent Patents.

To RICHARD BEARD, Jun., *of Clapham, and* WALTER DOWNING, *of Battersea, for improvements in the manufacture of artificial leather, and in colouring, dyeing, or finishing the same; which latter improvements are also applicable to the colouring or dyeing of the ordinary leather cloth.*—[Dated 24th August, 1864.]

IN carrying out this invention, one or both sides of a fabric, by preference an open linen cloth, are first coated with a composition of oils and resins or gums, and a fleece or fleeces of cotton or other fibre are made to adhere thereto by means of pressing rollers. The most ready method is to spread, by the ordinary steam-heated spreading machines, the composition on one or both sides of the fabric, and to pass the same through steam-heated rolls, also passing through the rolls the fleece or fleeces of fibre on one or both of its sides. When it is desired that the surface of the fleece when on the fabric should be left clean, and not be penetrated too much by the composition, the rollers must only be slightly warm, and not much pressure applied by them to combine the material. When this is not of consequence, a more complete union and a better result will of course be obtained by pressing firmly, and allowing the composition to penetrate. In this case it may be necessary to keep the rollers lubricated with ground talc (French chalk) or other convenient substance, which will prevent the materials from adhering to them, and also the folds from sticking together as they are wound off, or from the pressing rollers. The fabric and fibre thus

combined should then be hung in a warm temperature, that it may completely dry; thereby the oil composition becomes perfectly oxidized. It will then be insoluble by the oil compositions usually employed in the manufacture of leather cloth, which can then be spread over the surface in successive coats, as is usual in the manufacture of leather cloth, whereby the side so dressed may be made to assume the appearance of dull or japanned leather, as may be desired. In some cases, in order to obtain increased thickness of fibre, the surface is again covered with the same adhesive composition as at first adopted, and another fleece is attached thereto, as before. Ground leather or other similar dust is sometimes spread on one side of the fabric, either with or without the fibre, so as to give the appearance of leather on the back side of the manufactured material. This may be done by throwing in the ground leather or other dust, either in addition to the fibre or in place thereof, as the fabric is passing into the rolls, so that the whole may be well pressed together; or the leather or other dust may be applied separately, as directed for additional thickness of fleece. As little composition should be used in uniting the fabric and fibre as will firmly bind all together, so that the manufactured material may remain as soft as possible; but when desirable the combined material may, at any stage of the dressing or coating with the ordinary compositions used in making leather cloth, be dressed with the oils or grease employed in currying leather, which will, as with leather, give softness and flexibility; a small quantity will of course suffice. When the artificial leather is to be japanned, then this application of non-drying oil or grease must precede the japanning. The composition for uniting the fabric and fleece is by preference made by a mixture of boiled oil or boiled oil and oil scrapings and resins or gums, so prepared that when dried or solidified by absorption of oxygen the combined fabric and fibre and composition shall not become hard or brittle, but whilst the adhesiveness and cohesiveness requisite are obtained, the flexibility of dried oil is maintained. The proportions of oil and resinous matter may vary according to purposes and quality of material required to be made therewith, and the kinds of oil and of resinous matter may vary in themselves and in proportion one to the other, according as their relative qualities and characteristic natures or properties vary; that is to say, that if very hard resins are used, then a greater proportion of non-drying oil may be desirable; also if a larger proportion of dried oil scrapings is boiled with the oil, then less resinous matter may suffice. The following has, however, been found a good combination:—56 lbs. linseed oil and 56 lbs. dried scraping of ditto, boiled to as thick a consistency as possible; 7 lbs. common rosin; 21 lbs. Burgundy pitch; and 7 lbs. commonest india-rubber (if in a resinous state from decomposition it will still avail). The whole having been melted together, add about 5 lbs. cod oil, or other non-drying oil; grind the whole in convenient steam-heated mixing rolls, with from 30 to 35 lbs. white lead (dry), or burnt umber, or other driers. This must be spread warm, and if of too thick a consistency may be thinned with some volatile spirit, such as mineral naphtha.

In some cases, in place of applying the oil compositions used in the manufacture of leather cloth to the fabric coated with fibre as above described, the surface coating of the fibre that has been applied to the

fabric is dyed, aniline dyes being employed by preference. The surface of the material may then be varnished with a suitable varnish. In such cases the surface of fibre must be kept clean, as before described; at the same time it must be pressed as flat as possible. This surface is then coated with a small quantity of size or albumen, and the same is dyed by floating over it the desired colour,—repeating the process, as may be requisite, to get a good surface colour, and pressing between rollers between each coat. The surface may then be varnished with any suitable elastic varnish.

The dyes from aniline and its homologues, employed for colouring the leather, are obtained by dissolving the crystals of the aniline dyes in fusel oil that has been rendered anhydrous; to render fusel oil anhydrous, it should be mixed with gum arabic, by which the water will be absorbed; the gum arabic will settle to the bottom of the vessel containing the oil, and the oil may then be drawn off; other means may, however, be employed for rendering the oil anhydrous. It is preferred to dissolve in a gallon of the oil half an ounce of roseine or other crystals, but this will vary according to the shade of colour desired. When the colour has been dissolved in the oil, two fluid ounces of sulphuret of carbon and one ounce of ether are added. In order to colour leather cloth with this mixture, the surface of the leather cloth is floated or painted over with it, and that the oily compositions of which the surface of the leather cloth is composed should have pigments mixed with them of somewhat the same colour as the colour with which it is to be subsequently coated. This process may be repeated to get deeper and richer effects of colour, and spirit varnish may or may not be mixed in small proportions therewith for all or only the last coat of dye. The coatings of dye dry at ordinary temperatures. In order to produce a bronzed effect on the surface of leather cloth by the use of aniline dyes, the aniline dyes employed are dissolved in spirit, and the surface of the leather cloth is covered therewith. For this purpose four ounces of roseine or other crystals are dissolved in one gallon of pyroxilic spirit, and four ounces of acetic or sulphuric ether is added thereto. After coating the surface of the leather cloth with this solution, it is subsequently coated with any suitable varnish.

The advantages claimed for the improvements above described are, first,—an artificial leather is obtained more closely resembling leather by reason of not showing the threads of the fabric on which it is made, as is the case with ordinary leather cloth; second,—that from the fabric and fibre being united with a composition, the artificial leather can be cut with a raw edge without tendency to ravel out as in an ordinary woven fabric; third,—that a much less expensive fabric can be employed than in ordinary leather cloth, at the same time that the artificial leather or leather cloth possesses increased strength; fourth, —that by the dyeing process increased richness of colour is attained at a less expense than heretofore, and that a nearer approach to the appearance of leather is gained, together with greater durability than is obtained by the painted and varnished surface of ordinary leather cloth.

To David Auguste Burr, *of Washington, U.S.A., for improvements in lightning arresters for protecting electric telegraph apparatus,—being a communication.*—[Dated 16th January, 1864.]

These improvements relate chiefly to the employment of charcoal, powdered glass, powdered sulphur, powdered amber, or their equivalents, as electric conductors for separating and discharging atmospheric electricity from the wire circuits of telegraphic lines.

In Plate V., fig. 1 is a plan view of the lightning arrester, and fig. 2 is a section of the same. A, is the wooden frame of the arrester. Solid pieces of charcoal B, are placed within the frame A, between the metallic plates C, C, and D, as clearly shown in fig. 2. The upper plates C, C, and the lower plate D, are screwed down at their edges upon the frame A, so as to cover its central spaces. Ordinary "binding posts" or pillars *b*, *b*, are screwed down through apertures in one end of the plates C, C, near the edges thereof, into the frame. Similar binding posts b^1, b^1, are screwed into the opposite end of the upper surface of the frame beyond the edges of the plates C, C, with which, however, they are connected by means of small platinum wires secured to the one and the other. The ends of the wires from the main line are secured in the binding posts *b*, *b*, by suitable binding screws, and the ends of the wires extending to the recording instruments and magnets are held in the same manner in the opposite binding posts b^1, b^1. The connection between these wires is formed, and the main "line circuit" of the telegraph rendered complete, by the intermediate brass plates C, C, and the platina wires *a*, *a*, as shown. The copper plate D, which covers the lower side of the frame, is connected directly with the earth by means of a large wire or chain. The charcoal (or other equivalent material) B, placed in the spaces of the frame between the upper plates C, C, and the lower plate D, forms a superior conductor of atmospheric electricity from the plates C, C, to the plate D, from which it is led to the earth by the large ground wire. In order to obtain symmetry in the arrester a tongue from the plate D, is extended and bent up over the end of the frame; and the binding post E, which holds the earth wire, is screwed into the top of the frame through this portion of the plate. The charcoal, which is placed between the upper and lower metallic plates C, C, and D, may be used either pulverized or solid; if used solid, the grain of the wood should be placed at right angles to the plates, and in this case fine metallic points may with advantage be fixed in the charcoal, so that their ends shall extend up so as almost to touch the upper plate, without, however, coming in positive contact therewith. Powdered glass, powdered sulphur, powdered amber, or other substances possessing similar conducting properties, may be substituted for the charcoal B.

The arrester may be made to receive but one set of circuit wires, and but one cavity for the immediate charcoal filling between the upper circuit plate and the lower discharging plate.

The object of this invention is to protect the apparatus upon telegraph lines from the evil effects of an excess of atmospheric electricity upon the lines, by separating and discharging this electricity from the telegraph wires to the earth without interrupting or interfering with the current of voltaic electricity passing over the same.

In the instrument above described, the voltaic current from the distant stations, arriving in the direction illustrated by the arrows in fig. 1, will pass directly on across the brass plate C, which completes the metallic circuit of the main line, and so through the platinum wire *a*, on to the recording instruments and magnets. If, however, a current of atmospheric electricity following the wires arrives at the plate C, the small size of the platinum wire will obstruct it (although allowing free passage to the voltaic current), and at the same time the charcoal (or its equivalent, as described) will present a most excellent conductor, which will at once divert and lead it off through the lower plate D, to the large earth wire, which will carry off and dissipate it. The superior conducting power of the charcoal will thus protect the small arresting wires *a*, *a*, which would otherwise be melted.

The patentee claims, "the mode of separating and discharging atmospheric electricity from the wires forming telegraphic circuits by the use of charcoal, powdered glass, powdered amber, powdered sulphur, or other substances having similar conducting powers, as described."

To AUGUSTE BERTSCH, *of Paris, for improvements in lightning conductors, for preventing atmospheric electricity damaging electric telegraph instruments.*—[Dated 15th September, 1864.]

THIS invention relates to means of preventing atmospheric electricity from damaging electric telegraph instruments. The lightning conductor is composed of two parallel copper plates retained at a distance apart, and insulated from one another by four small posts of insulating material. Each plate carries about 300 sharp points, and these points are carried on the sides of the plates that are towards each other; the extremities of the points carried by the opposite plates being brought to a distance of about $\frac{1}{25}$th of an inch from each other. One of these plates is attached to the side of a cast-iron box or case, which is placed in connection with the earth by a wire or band of copper; the opposite plate is connected by a stout copper wire with the line wire of the telegraph. This copper wire, where it passes out through the top of the case, passes through a tube of porcelain fixed in a water-tight manner to the top of the case, and the exterior of the top of the porcelain tube is made of a bell shape, similar to the insulators now used for supporting the line wires of telegraphs; the copper wire which passes up to the line wire is thus insulated from the box or case.

In Plate VI., fig. 1 is a vertical section of the improved lightning conductor. *a*, *b*, are the two metallic plates, separated and insulated one from the other by posts *c*, *d*. Each plate carries about 300 sharp points, by preference made of copper, either silvered or gilt. The extremities of the points carried by the opposite plates are brought to a distance of about $\frac{1}{25}$th or as close as $\frac{1}{50}$th of an inch apart from each other. These plates are enclosed in a rectangular box E, of cast iron, which is cast in one piece, one side only of the box being left open. This side is afterwards closed by a thick sheet of glass, through which the interior of the apparatus can be seen. The plates are fixed in the

rectangular cast-iron box by one of the plates *a*, which is furnished with points, being closely fixed to the back of the box either by screws passing through from the exterior or otherwise. The cast-iron case E, is put in communication with the earth by the copper wire *u*, and the metal plate *b*, is put in connection with the line wire of the telegraph by the metallic rod *l*, *m*. *i*, *k*, are two lugs or ears on the exterior of the box, which permit of the apparatus being securely fixed by means of screws, or otherwise, to telegraph posts, to walls, to the entrance of tunnels, or wherever the effects of condensation and quantity of static electricity is to be feared. The metallic rod *l*, passes out from the interior of the case through a tube of porcelain *p*, fixed by a suitable cement in a water-tight manner to the interior of the tube *n*, which screws into an opening in the top of the case. On the top of the porcelain tube *p*, is formed an inverted cup or bell *r*, which keeps off rain from the greater portion of the tube. The rod *l*, rises above the top of the bell, and above the bell it has formed all around it a projecting flange *o*, which covers the top of the opening through the tube *p*. This flange is drawn down on to the top of the bell by a small nut screwing on to the lower end of the rod. The upper end of the rod *l*, is readily connected to the line wire by means of a copper wire attached to the end of the rod by the binding screw *t*.

In order that perfect security may be attained, it is preferred, on account of the large amount of static electricity which has sometimes to be placed in equilibrium with the earth, to employ, together with the apparatus above described, an apparatus of the description now commonly used, in which a fine wire forms as the conducting wire between the line wire and the telegraph instruments, in order that if there be any discharge of static electricity through this wire, the wire may be burnt, and the instruments remain uninjured. This second instrument is placed on the interior of the building in which the telegraph instruments are contained. It is, however, important that this class of apparatus should be so constructed as to work continuously and independently of the will of the operatives; to which end the apparatus is arranged in such manner that when the fine wire which connects the line wire with the instrument is burnt, the wire is immediately replaced by another fine wire. Fig. 2 shows a side view, and fig. 3 an end view, of an apparatus so constructed. The apparatus is composed of a cylinder, terminated at one end by a disc *a*, and at the other by a disc *b*; the disc *a*, is connected with the earth, and the disc *b*, with the telegraph instruments. Around the disc *a*, are placed a number of spring hooks *c*, *p*, *e*, *f*, insulated one from the other, and also from the earth. The springs r, r^{1}, r^{11}, r^{111}, constantly tend to draw the hooks towards the disc. The opposite disc, which is in connection with the instruments, is also provided with an equal number of hooks, and is connected to the cylinder in such manner as to be insulated from it at the point *i*, *i*, for dynamic electricity. Fine wires f, f^{1}, are stretched between the hooks on the disc *a*, and the hooks on the disc *b*. Within the disc *a*, is a helical spring *r*, (see figs. 3 and 4) which constantly tends to rotate the cylinder. The bobbin is supported between two standards *o*, *o*, by an axle, which at one end is connected with the earth, and at the other with the telegraph instruments by the clips *l*, *k*. Near the opposite disc is another

clip k^1, in which is held the extremity of the line wire, and which carries a contact piece, against which the head of one of the spring hooks firmly rests. On the opposite side of the disc is a third clip k^{11}, communicating with the earth wire, and which may also carry a contact piece. This contact piece is not required if the cylinder communicates with the earth by the contact piece k^1, and by the foot of the standard which supports the axle v, of the cylinder. In the first case the disc carries on its edge a plate of copper, which, when the last of the fine wires has been burnt, rests on this contact piece, and instantaneously establishes the communication between the line and the earth. The cylinder s, is formed of a metallic tube, carrying points, which are retained at a very short distance from the fine wires. Atmospheric electricity has therefore always an easy path for regaining its equilibrium with the earth, and it will thus be seen that the apparatus is constantly in action as a discharger. When one of the threads is burnt, the hook which establishes the contact between the line wire and the instruments is withdrawn by its spring into the disc; the cylinder is then caused rapidly to turn by the spiral spring r, which brings the next hook up to the contact piece, which thus forms a stop, to prevent the cylinder from turning further. The communication is thus re-established by the new fine wire placed in the circuit. This change is effected in the sixtieth of a second, that is to say, in so short a time as not to interrupt the working of the telegraph. When the last of the fine threads is destroyed the communication between the line wire and the earth is instantaneously made direct by a projection from the disc, which takes the place of the last hook.

To WILLIAM DANGERFIELD, *of Chalford, Gloucestershire, for an improved mode of, and apparatus for, bending wood for the handles of walking sticks, umbrella and parasol sticks, and other purposes.*— [Dated 5th March, 1864.]

THIS invention consists principally in a novel mode of applying heat to the wood of which walking sticks are made, for the purpose of softening its fibres, and then bending down the stick and securing it in place by means of a clamp and a flexible piece of metal.

In Plate V., fig. 1 is a plan view of the apparatus; and fig. 2 is a detached view, in vertical section, of the hollow or tubular mandril around which the sticks are bent, and showing more particularly the manner of heating the same.

In carrying out the invention, the ends of the sticks (which are to be bent) are first softened by placing them in moist sand, which may be heated if required. After remaining in the sand for a suitable time the sticks are to be removed to the bending apparatus. That end of the stick b, which is to be bent to form the handle, is to be held securely in the jaws of a clamp or vice a, a, and the extremity of the stick b, is then drawn round or bent over a tube or hollow mandril c, provided with an annular half-round recess. The diameter of this mandril should correspond with the hook or curve the stick is intended to receive, and the groove should be of a size to suit the diameter of the stick. Inside this tube or hollow mandril a gas jet or burner d, is

introduced, for imparting heat to the tube or mandril, which heat is transmitted to the stick from its being drawn into close contact therewith. The stick is kept in this position by means of a band of steel *e*, which is bent over the stick to retain it in a bent position. This steel band is held in the vice in contact with the stick to be bent, as shown at fig. 1, and it is fitted at one end with a handle for operating it, and at the other with a stud for carrying a catch or hook *g*, which drops over the handle of the steel band when the same is lapped round the mandril, and thereby retains it together with the bent end of the stick *b*, in the curved position. Heat may be applied externally to the stick, if thought desirable, by causing a jet of ignited gas to play upon the steel band *e*.

As an obvious modification of the above-described apparatus, a hollow chamber of suitable shape may be used as the "former" and heated by gas as described, and in place of the flexible band *e*, a solid piece or block of metal of suitable form may be applied to the outside of the curved stick and heated from the outside in any convenient manner. When the end or handle of the stick has remained sufficiently long in this bent position to receive a permanent "set," it is released from the apparatus, and the operation may be repeated.

The patentee claims, "the application of a flame of gas or other combustible fluid or liquid, as described, for softening the fibres of the wood while being bent, in combination with a clamping apparatus for securing the wood in its bent form until the fibres are set, so that the hook may remain permanent, as set forth."

To WILLIAM THOMAS CHEETHAM, *of Ashton-under-Lyne, for improvements in obtaining hydraulic motive power.*—[Dated 4th June, 1864.]

THIS invention consists in employing a wheel with vanes thereon surrounded by an annular chamber furnished with orifices which direct the water upon the vanes, but the water after it has reached the vanes does not, as in the case of an ordinary turbine, pass onward to the centre or outward to the circumference according as the guide floats are within or without the revolving part, but returns in a direction nearly parallel to that in which it was delivered, and escapes between the annular chamber and revolving wheel.

In Plate V, fig. 1 represents in vertical section one arrangement by which the principle of the invention may be carried into effect, and fig. 2 is a plan view, one half thereof being in section. *a*, is a revolving shaft through which the power is to be transmitted; upon this is mounted a wheel *b*, the circumference of which is grooved out, as seen in fig. 1. The annular groove thus formed is provided with partitions *c*, constituting vanes, but these partitions are not in this instance radial lines, but are of a curved form, as seen in fig. 2, and the two views taken together show, therefore, that a series of recesses *d*, are formed with curved sides in each direction, constituting cup-formed chambers. Around the wheel *b*, is placed a water chamber *f*, the inward circumference of which has an annular chamber divided into compartments by stationary vanes *g*, similar to guide floats of ordinary turbines, and from the inward ends on each side of these

guide floats the water chamber *f*, recedes at an angle, as seen at *f**, in fig. 1. The water from the source of supply enters by a pipe *h*, and fills the annular chamber *f*; from thence it passes between the guide floats *g*, which direct it to the circumference of the wheel *b*, projecting it upon the vanes *c*, formed thereon. Arriving in contact with these, it drives forward the wheel *b*, but as a reactionary force takes place, it passes along the doubly-inclined sides which constitute the vanes *c*, and escapes upward and downward between the wheel *b*, and annular casing *f*, as seen by the arrows in fig. 1,—the tapered form of the inward circumference of the chamber *f*, allowing space for its free escape.

The above description explains the peculiar feature of the invention, but it is capable of modifications, as shown in section at fig. 3. The wheel *b*, constructed as before described, is mounted over the annular chamber *f*, which delivers the water to the cup-formed vanes *c*, through the medium of the guide floats at *g*; the plan view of this arrangement would show the floats *c*, and guide floats *g*, curved precisely as in figs. 1 and 2. In fig. 4 the revolving wheel *b*, is placed on the outside of the stationary annular chamber *f*, and guide floats *g*, which receive their supply of water from a pipe *h*, leading into a chamber *k*. In order to regulate the quantity of water which shall be allowed to act upon the revolving wheel, and therefore to govern the power, the spaces between the guide floats may be partially closed by a sliding ring as is practised in turbines, or there may be a separate slide for each space or for any series of such spaces. In fig. 1 is shown the application of one slide at *l*, capable of being raised or lowered at pleasure.

The patentee claims, "the use of a revolving wheel fed by an annular chamber furnished with guide floats, the former being so formed as to return the water somewhat in the direction in which it was delivered. Also the tapered form *f**, ot the chamber which delivers the water to the wheel, whereby the said water is enabled to escape freely."

To JOHN JOSEPH PARKES, *of London-street, Paddington, for improvements in the application of gas and other fluids or liquids for lighting and other purposes, and in apparatus connected therewith.*—[Dated 18th August, 1864.]

THIS invention relates to a means of applying gas on railway lines in tunnels, or elsewhere, in order to afford light, while effecting repairs to the permanent way, or otherwise; this has hitherto been but imperfectly effected by means of naphtha or other oil lamps, which are suspended at the desired point.

The apparatus may be fitted to ordinary gas mains or to main pipes laid for the purpose, but in either case is only intended for the temporary lighting of places, such as on lines of railway for their repair or other purposes.

In Plate V., fig. 1 represents a section of a stand pipe and apparatus applied to a gas main pipe, according to this invention. A wood block is shown as let into the ground to protect the stand pipe, as also the clip for attaching the flexible delivery pipe; and fig. 2 represents the gas nozzle or jet detached, with hook for hanging it upon a pointed standard, which may be fixed into the ground in the position the gas light

is required. A, is the gas main, either an ordinary main or one laid on, for the purposes of these temporary lights; B, a T-piece and fixed stand pipe applied thereto at intervals; C, a valve box permanently fixed on the piece B, in which is disposed a valve *a*, fitting down on a seat *b*; *d*, is a valve stem fitted in a left-hand screw thread *e*, inside the box C, by turning which it is raised from or depressed on its seat. The stem *d*, is continued upwards and out at the conical top of the valve box. The upper part of this valve stem is hollow, and gas, which passes up through the valve *a*, when open, enters the hollow stem by openings *f*, *f*. A hole *g*, is made in the side of the stem *d*, near the top, which permits gas to escape upwards, when the valve *a*, is open. The hole *g*, rising above the conical top of the valve box C, gas passing up through the valve *a*, when slightly open, will not find access to the hollow of the valve *d*, by reason of the disc plate or washer *h*, with a leather face placed on the lower stem of the valve *a*, and pressed upwards by a spring *c*, which keeps it against the opposing face *i*, formed on the stem *d*, and from which the holes *f*, *f*, enter. When the valve stem is fully raised, the plate *h*, comes in contact with a certain piece or flange *k*, which stops it, and the face *i*, recedes, leaving open the holes *f*, *f*. Apertures made through the curtain piece *k*, permit the gas to enter between the plate *h*, and face *i*; gas is therefore free to enter the stem *d*, and escape at the hole *g*. as before explained, when the valve *a*, is fully open. The valve *a*, is faced with india-rubber. E, is a socket on the lower end of the upright pipe F, forming what is termed the key; in this socket is a diaphragm or internal flange *l*, with a soft packing *m*, of india-rubber. This socket screws on the top of the valve case C, with a right-hand screw thread, and the packing *m*, coming against the conical top thereof makes a gas-tight junction therewith, a flat side is formed on the stem *d*, which is then of a D form, a corresponding part is formed in the inside socket E, which therefore fits on and turns the stem *d*, at the same time that the key is screwed on its right-hand screw; the screw *e*, which has a left-hand thread, raises the valve at the same time. These screws are so arranged, that the desired positions of the parts correspond and are arrived at, when the key is applied or removed; that is to say, when screwed on the valve is fully raised, and when removed it is closed down tight. When the valve *a*, is opened as before described, gas is free to pass from the main A, up the pipe F. A guard piece H, is fixed to the valve case C, down through which the socket E, is inserted, having a projection passing down a recess, with a stop to prevent the socket E, being turned the wrong way; a stop is also provided for contact when the socket E, is fully screwed on the case C. The pipe F, is fitted at top with a T-piece having fixed on each end a nose piece *p*, with an enlarged end and groove around it, into which the jaws *r*, *r*, of the clip *k*, take and hold it in position. Inside the piece *p*, is a sliding tube *t*, pushed outwards by a spiral spring *s*; this tends to press a valve at the inner end of tube *t*, against the socket *u*, in which it is fitted. There is a lateral hole *v*, near the back end of the tube *t*, and when it is pushed inwards beyond the socket *u*, gas will be free to enter and pass out through the tube *t*. *w* is a wood hand-hold fixed on a socket piece and tube *x*, to which the clip *k*, is applied; the nose of the tube *x*, being pressed against the end of the tube *t*, and held up thereto by the clips *r*, *r*,

and thereby making a gas-tight junction. The piece *t*, is at same time thrust back sufficiently to open the hole *v*, and put the spring *s*, in the necessary state of tension to give the pressure required for the junction. The clip *k*, consists simply of two jaws. with a thumb lever pivotted on the tube *x*, at the point *y*, the jaws fit in the groove *p*, and hold the parts firmly in contact, they being compressed together by a strong india-rubber band *z*, or other suitable spring. A pipe L, is fitted on the opposite end of tube *x*, and a piece of flexible india-rubber tube M, of any suitable length, with the nozzle or jet piece P, is attached thereto, and the opposite end is furnished with a hook *j*, by which it may be hung on a supporting rod, and moved from place to place as required within the range of the length of the tube M. T, is the hinged cover to the wood block, enclosing the valve box C, hinged so as to close by its own gravity on withdrawing the key-piece E, after turning the gas on or off; this cover is bevilled on its upper surface so as to present a smooth surface. V, are screws to steady the valve box C, in the block. Water and other fluid mains may be fitted and applied in the manner described with reference to gas in order to get a supply for temporary purposes, the same apparatus being applicable in all cases.

The patentee claims, "the temporary application of gas for lighting in the manner, and by means of the apparatus, described. Also the application of such apparatus to water and other fluid mains or pipes, as and for the purposes described"

To GERIN GABRIEL BOGGIO, *of Paris, for a new or improved process for extracting the oil contained in the flour or oleaginous seeds, for distilling, rectifying, and evaporating volatile substances, for preparing volatile oils or essences and extracts for dyeing and medical purposes, for desiccating animal and vegetable alimentary substances, plants, roots, and flowers, and for ventilating.*—[Dated 23rd August, 1864.]

THIS invention relates to divers applications of the vacuum by means of a pneumatic machine, for extracting volatile oils and drying alimentary substances.

For the extraction of oils the inventor reduces to a coarse powder, in the usual way, the seeds of mustard, linseed, sweet or bitter almonds, and other oleaginous seeds, which powder he places in an air-tight chamber, provided with a tap at its lower part, and with a cover. On this powder a sufficient quantity of purified sulphuret of carbon is poured, to carry off all the oil contained by the seeds, and allowed to stand for a few hours; then, on opening the tap, the liquid runs into a receiver placed below. To make sure of the entire separation of the oil, a few drops of sulphuret are run through the apparatus on to a piece of paper: if no grease spot is formed, the result is attained; but when the contrary is the case sulphuret is added until the separation is complete. The tap is then shut, and the apparatus containing the powder is brought into communication with the suction valve of a pump chamber, with suction and forcing valves, worked in the ordinary way; a vacuum being now formed vapourises the sulphuret of carbon, which is received in a state of vapour in the pump chamber, and driven from

thence into a serpentine, or other condensing apparatus, when it is received in a condensed state below the surface of water (which prevents all emanations) in an ordinary receiver; thus all the sulphuret remaining in the powder is removed. By employing two pump chambers or two bellows, the forms and sizes of which may vary, a continued operation is obtained.

The same process is employed for separating the sulphuret from the oil by placing in communication with the exhausting valve of an air pump the receiver in which the oily mixture is contained, when the oil only remains in the receiver. By this process the patentee obtains flours, which, far from losing any of their properties, acquire new ones; thus their quality is increased in proportion to the oil and water eliminated (about 40 per cent.). They also acquire by this process an unlimited degree of preservation at all temperatures; consequently the flours of mustard and linseed, amongst others, would bear sea voyages in all climates.

The patentee also employs distillation by steam or hot water around the receivers, for separating the sulphuret from the oil, but prefers the pneumatic process, as being more advantageous in all respects. The oils thus obtained may be applied to their ordinary uses.

With the mustard flour deprived of oil, blisters are prepared as follows:—Upon paper or tissue of any kind a sufficiently thick coating of the powder is fixed by means of a weak aqueous solution of glue or gum, which is dried quickly either by artificial heat or in a box or case hermetically closed, from which the air is exhausted.

By sifting and aromatising, mustard flour for all tastes and linseed meal are obtained, which may advantageously replace the flours or meals known as almond pastes, for toilet purposes, because this flour contains mucilaginous and softening properties in a much larger proportion than the almond pastes; and besides, the prepared flours or meals never become rancid.

In distilling and rectifying sulphuret of carbon, benzine, petroleum, alcohol, ethers, aromatic waters or vinegars, acetic acid, and similar substances, these substances are placed in receivers, which, according to circumstances, are made of brass, cast iron, pewter, wrought iron, glass, porcelain, glazed ware, enamelled cast iron, wood, or other suitable substance or substances. The receivers being placed in communication with the suction valves, exhaustion is produced above. The recipient which receives the condensed vapours may be so graduated as to show the quantity distilled.

In preparing and rectifying volatile oils or essences, the flowers or other matters containing the aromatic volatile oils are placed in glass, china, or enamelled receivers, and, if necessary, alcohol, ether, sulphuret, or water is added. The patentee then proceeds in the manner above described. The oil is collected in a florentine receiver. Oils or essences are rectified in the same way.

For the extraction of sulphuret from scoured wools, the wool is placed in boxes or chambers provided with openings in their lower parts. These openings communicate with the suction valves of pumps, and the vapours are condensed and collected as above.

Simple Evaporation.—For this purpose the patentee employs pumps, the capacity of which varies according to circumstances. This capacity

may be as great as 1000 quarts or more for each of them, only the vapours are thrown out; thus colouring extracts for dyeing are prepared. In the same way medicinal extracts are obtained. The same process is used for drying threads and tissues after washing, with this difference, that they are placed in large boxes or rooms, to which the air may enter at will.

Desiccation of Meat or Vegetables.—In order to keep meat and vegetables in a fresh state, they are placed in closed boxes, and operated upon as above.

Ventilation.—In order to ventilate places in which the air penetrates with difficulty, such as cellars, holds of vessels, and similar places, the patentee, by means of the suction valves of pumps or bellows, introduces air, either in large volumes or divided, and in this case the disengaging tubes serve for carrying off the foul air.

The claims are, "First,—preparing powders, flours, or meals deprived of oil by means of sulphuret of carbon. Second,—extracting their oils by the vacuum or by distillation. And, Thirdly,—applying the vacuum to distilling, evaporating, desiccating, and ventilating."

To Antoine Marie Joseph Count de Molin, *of Paris, for an improved electro-magnetic engine.*—[Dated 2nd September, 1864.]

This invention consists, first, in the particular position in which the electro-magnets of an electro-magnetic engine are situated in respect to each other, and to their respective armatures, whereby constantly but a comparatively very small space is left between the armatures and their respective electro-magnets before these latter become magnetized; second, in the particular wave-like rolling motion imparted to the parts carrying the armatures, which motion resembles the rolling of a top on the floor towards the end of its revolving motion.

In Plate V., fig. 1 is a side elevation of the improved electro-magnetic engine; and fig. 2 is a plan view of the same taken over the rings which carry the armatures, and with the frame of the machine removed; Z, is a strong frame, on the bed-plate of which are securely fixed concentrically, and at equal distances apart, a series of electro-magnets A^1, to A^8, of equal size and strength. The machine is represented with eight of these electro-magnets, but any other number exceeding three might suit the purpose, though it is preferable there should be at the least eight of them. In the centre of the bed-plate I, is fixed a small standard *k*, on the top of which rests, and is allowed to revolve, a steel cone *i*, forming the lower end of an arbor M, fixed in the centre of two rings I^1, and I^2, of brass; the inner ring I^2, being provided with arms *j*, and a central boss j^1, whilst the armatures B^1, to B^8, fixed against the lower surface of the rings I^1, and I^2, connect these latter together. The top *m*, of the arbor M, revolves in the hollow part of a small crank arm M^1, so as to form a ball-and-socket joint. The crank M^1, is fixed to the lower end of a vertical shaft N, revolving in bearings provided in the cross-bars N^1, and N^2, of the frame Z, whilst at the top the shaft N, is provided with a fly-wheel N^3, and with fast-and-loose pulleys for transmitting the revolving motion of the shaft N, to any parts to be driven by the machine.

From what has been described, it will be readily understood that as each of the armatures B^1, to B^8, is situated exactly above its respective electro-magnets A^1, to A^8, if each of the armatures be attracted in its turn by its respective electro-magnet, each armature will, in its turn, be carried in contact with its respective electro-magnet, and consequently a wave-like rolling motion will be imparted to the rings I^1, and I^2.

Various devices might be resorted to for causing in turn each of the electro-magnets to be attracted by its respective armature, either merely by the agency of the electro-magnetic force or by the intervention also of the fly-wheel N^3.

The following arrangement, for instance, might be adopted:—P, is a wooden board fixed in the frame Z, through a hole in the centre of which board passes the iron arbor N, by means of a ring *n*, of ivory, bone, or other suitable isolating material. The arbor N, is kept isolated from a boss n^1, of brass, provided round the ring *n*,—both ring *n*, and boss n^1, being securely fixed to the arbor N, by a screw *p*; whilst on the boss n^1, is fixed one end of a steel spring R, the free end of which, during the revolution of the arbor N, presses on the top of a series of brass plates a^1, to a^8, fixed on the board P, in a concentric manner round the arbor N, and at equal distances apart. The length of the spring R, is such as always to press simultaneously on two succeeding plates, each of which latter is connected, by means of a conducting wire, to the wire of the outer bobbin A^a, of its corresponding electro-magnet, viz., the plate a^1, to the electro-magnet A^1, the plate a^2, to the electro-magnet A^2, and so on. On the other hand, a spring *q*, of steel or other suitable elastic metal, is fixed with one end to the board P, whilst its other or free end presses against the boss n^1. The fixed end of this spring is connected, by a wire *w*, to one of the poles of an electric battery, the other pole of which is connected, by a wire u^1, to a spring or conductor w^2, to which are connected all the wires b^1, to b^8, of the bobbins A^b, of the electro-magnets. The spring R, must be of such length, and curved in such manner, that at the very moment its free end leaves one of the plates, a^8, for instance, the position of the rings I, and I^1, will be such that the armature B^8, is in close contact with its electro-magnet A^8.

The mode of working the engine is as follows:—Supposing the armature B^8, to be in close contact with its corresponding electro-magnet A^8, viz., actually pressing on the top of this latter, the position of the spring being such that this electro-magnet is already demagnetized, viz., the electric current broken, the armature B^6, beginning at this moment to be attracted by its electro-magnet A^6, whilst the armature B^7, will come in close contact with its electro-magnet A^7, the spring R, will have left the plate a^7, and advanced towards the plate a^5, continuing during this time to press against the plate a^6; the armature B^7, will now have been attracted and carried in close contact with its electro-magnet A^7, and this latter at the same time will become demagnetized by the breaking of its electric circuit; consequently each of the armatures will in the same manner, each in its turn, be carried down and brought in close contact with its respective electro-magnet, and thereby the above-described wave-like revolving motion will be imparted to the rings I^1, and I^2, and by means of the arbor M, a revolv-

ing motion transmitted to the arbor N, and, further, to any machinery to be driven by the engine.

The patentee claims, "the general arrangement, combination of parts, and mode of working, of his electro-motive engine, substantially as described."

To EDWARD RIGGE LLOYD *and* SAMUEL LLOYD, *of Birmingham, for an improved method of securing tubes in tube sheets,—being a communication.*—[Dated 5th September, 1864.]

THIS invention consists in the employment of a ferrule having a concave outer surface or periphery of a slight taper form, and of such diameter that it may be driven into the end of the tube in such manner as to expand it, and to cause the end of the tube to close around the hole in the tube sheet, and thus form a tight and permanent connexion of the tube to the tube sheet, while admitting of the tube being of equal diameter throughout.

In Plate V., fig. 1 is a longitudinal central section of a portion of a boiler flue, having one end secured in the tube sheet or plate according to this invention. Fig. 2 is a longitudinal central section of a flue and ferrule, the latter not being driven in the former; fig. 3 the same as fig. 2, with the ferrule driven in the flue. A, represents a portion of a tube sheet or plate of a steam boiler, and *a*, is the circular hole in the sheet, which receives the end of the flue B. The edge of the hole *a*, is made convex, and it is rather larger in diameter than the flue B, to admit of the latter being expanded within it. C, is the ferrule, the exterior of which is slightly taper from its outer edge to the point a^1, and is grooved circumferentially, as shown at *b*, between the said parts, so as to form a concave surface. The inner part *c*, of the ferrule is bevilled or tapered quickly from the edge of the groove *b*, to the end of the ferrule. The external diameter of the ferrule at the inner edge of the groove *b*, at the point a^1, is equal in diameter to the interior of the flue B, as shown clearly in fig. 2.

The operation of securing the flue in the tube sheet or plate is as follows:—The end of the flue B, is inserted in the hole *a*, in the tube sheet or plate, and so adjusted as to extend a trifle beyond it. The ferrule C, is then inserted in the end of the flue B, a mandril D, placed against its outer edge, as shown in dots in fig. 2, and the ferrule driven in the flue, so that the ends of the flue and ferrule will be flush with each other, as shown in fig. 3. The ferrule C, in being driven into the flue, slightly expands its end, and a taper mandril E, is then inserted in the ferrule and driven through it, so as to expand the ferrule and also the end of the flue until the exterior of the latter is closed tightly all around the edge of the hole *a*, in the tube sheet or plate A, and at both sides of it, as shown in fig. 1. This expanding of the ferrule also causes its interior to be equal in diameter to the interior of the flue B, as shown, and consequently a flue of equal diameter internally is obtained throughout, and also a smooth unbroken surface with a tight and permanent connection of the flue and tube sheet or plate is obtained.

The patentees claim, "securing the flues B, of boilers in the tube

sheets or plates A, by means of ferrules C, grooved at their exterior, tapered and driven in the ends of the flues, so as to cause the ends of the same to close around both edges of the holes *a*, in the tube sheets or plates, and admit of the flue being of equal diameter throughout."

To EDWARD RIGGE LLOYD *and* SAMUEL LLOYD, *of Birmingham, for an improved method of expanding tubes in tube sheets,—being a communication.*—[Dated 5th September, 1864.]

THIS invention consists in the employment of hydraulic pressure for the purpose of forcing into the ends of tubes which are inserted into the tube sheets of boilers, ferrules, by which the ends of such tubes are expanded and made to close round the apertures in the tube sheets.

In Plate V., fig. 4 is a section of the improved apparatus for expanding boiler tubes. A, is a portion of a small or portable hydraulic hand press, having on the projecting stem a^1, of the main piston an oblong or T-head a^2; *b*, is a portion of the tube sheet of a boiler, and C, one of the tubes or flues as secured therein; D, the grooved ferrule; E, an adjustable hollow conical frustrum; and F, an adjustable clamp, represented as abutting both against the ferrule D, and the main cylinder head of the press A. The main cylinder of the press A, may be made about eight or ten inches long, and three inches diameter, more or less, and the whole press constructed so as to be easily operated by the hand lever in the usual manner, but with a head a^2, on the main stem a^1; and so also that after the stem has been pushed out to its full extent, it can be retracted by the positive power of the press. The head a^2, is oval or oblong in its transverse position on the stem, and the hole in the conical frustrum E, is of the same form, though a little larger in its transverse direction, so that the head and stem may be easily passed through the frustrum, and then turned a quarter round therein, to bring the larger diameter of the head across the oval hole in the frustrum, and thus prevent the withdrawal of the stem in a longitudinal direction when the whole apparatus is in operation. The frustrum E, is about three inches long, and its larger diameter at least equal to the inner diameter of the tube or flue C, whilst its smaller diameter is a little less than the inner diameter of the ferrule D, before it has been stretched in its application, as represented. The clamp F, consists of a pair of springy steel arms f^1, f^1, projecting from a boss f^2, through a hole in which the stem a^1, of the press may slide. The arms f^1, f^1, are curved in their transverse section at their ends, and also made so that whilst they will fit over the smaller end of the frustrum E, in their normal state, they will also yield apart sufficiently for the reception of the larger end of the same, as the frustrum is gradually drawn between them in the operation of expanding the ferrule D. The ferrule D, has a curved groove d^1, around in its outer side, and its greatest exterior diameter is such as will just permit it to be easily slipped into the open end of the tube or flue C, before the latter is expanded, and the hole through the boiler sheet B, for receiving the end of the tube exceeds the said exterior diameter of

the latter by a little less than twice the thickness of the shell of the ferrule at its groove d^1, so that after the flue has been secured in the sheet B, the inner surfaces of the ferrule D, and flue will be even, or of equal diameters.

Fig. 5 is a section of a modification of the above, in which the clamp or dog F, is of somewhat different construction to that shown in fig. 4, and consists of a number of steel strips or arms pinned or hinged to the boss f^2, and opening or contracting in the manner of claws. These may be kept in position by a collar slipped over them, or by binding with wire, and being jointed to the boss f^2, they are thus adjustable to various sizes of ferrules.

The operation of the machine is as follows:—The flue C, having been inserted in its appropriate hole in the sheet B, and the stem a^1, of the press A, having been pushed out to its full extent, with the clamp F, applied thereto, the ferrule D, is slipped upon the smaller end of the frustrum E; and the latter then slipped over the head a^2, of the stem a^1, entering the stem at the smaller end of the frustrum, until the head has passed entirely through it, when the frustrum is then turned a quarter round thereon, and the stem thus consequently secured against being withdrawn by a longitudinal motion. The parts being thus connected together, are lifted up, and the frustrum and ferrule inserted into the tube C, until the thicker end of the ferrule is brought flush with the end of the tube C, when the press is operated by means of its appropriate hand lever; one end of the clamp F, abuts against the end of the ferrule D, whilst its other end abuts against the main cylinder head until the frustrum has been drawn entirely through the said ferrule, and thus the latter, together with the end of the tube C, is expanded as desired, and as represented in fig. 1. Or, by another process, the ferrule may be inserted into the tube by a separate mandril and a few strokes of a hammer, before applying the hydraulic jack, which can be attached to the frustrum previously inserted in the tube after the ferrule is thus driven into its place, and the frustrum then drawn through the ferrule, in the manner described. The grooved ferrule D, produces the best fastening known for the purpose of securing the ends of the flues of tubular boilers, but the difficulties hitherto attending their expansion in place has prevented their general use; a screw and nut, with an operating lever necessarily five or six feet long, being the only means found sufficient for the purpose, and consequently the ferrules could not, for want of sufficient room in the fire chamber, be expanded in any of the tubes or flues which were not opposite to the fire-door opening, to say nothing of the constant liability of the screw thread to be stripped in the operation. The improved mode obviates these difficulties entirely, because the small hydraulic press can be readily introduced, handled, and operated as shown, entirely within the fire chamber of a locomotive or other tubular boiler, and the pressure required to expand the ferrules is supplied by the aid of a small amount of hand power. The clamp F, may be made in the form of a hollow cylinder, divided longitudinally into three or four parts, so as to permit it to expand with the ferrule as the frustrum is drawn forward; but it is believed the form first described is more simple and inexpensive of construction and quite as effective.

The patentees claim, "the employment of an hydraulic press pro-

vided with a head a^2, on its projecting main stem a^1, in combination with the frustrum of a cone E, and a suitable clamp F, arranged to operate together, substantially as set forth."

To PETER WILLIAM BARLOW, *of Blackheath, for improvements in constructing and working railways, and in constructing railway tunnels.*— [Dated 9th September, 1864.]

THE object of the first part of this invention is to economize the cost of power employed on railways where there are numerous stations, and consequently stoppages of trains at short intervals. To effect this, stationary power is employed at each station, arranged to start each train, and to continue propelling each train till it is brought up to, or has attained, such a speed or momentum as will enable it (without continuing the effort of the local power on the train) to pursue its course till it arrives at the next station where it is to stop. Although it is not essential, it is preferred to combine with such local application of power the constructing of the parts of railways between stations in such manner that there shall be an incline ascending each way to each station, so that the breaks are assisted in bringing the trains to rest on the arrival at each station.

The mode in which the local power is arranged to act in order to start, and for a time to continue the application of the power to propel the trains of carriages, may be greatly varied; but cylinders worked by hydraulic power are preferred, placed so as to put in motion driving wheels situated between or near the rails, so that their upper surfaces are level, or nearly so, with the upper surface of the rails, and are thus conveniently situated to haul a rope connected with the train. Such machine of less power may be used advantageously in railways worked principally by locomotive power to start heavy trains, and as a substitute for the locomotive and horse power used in large stations for shifting carriages and trucks.

When propelling trains without locomotive power, comparatively small steam power may be employed at each station, which shall be as continuously at work as may be, so that the power exerted thereby may be stored during the times intervening between trains, and the storing of the power may be by elevating water; or it might be other ponderous matter which is allowed to descend when power is required to start, and for a time to propel, a train till the desired or sufficient momentum has been attained to carry the train to the next station without a longer continuance of action of the local power on the train. The descent of the water or other ponderous matter may be caused to give motion to an endless rope or other mechanical arrangement, and thence to the train. The endless rope or other mechanical device is to be constructed so as to be readily disconnected from the train when the desired speed has been communicated to the train, depending in each case on the speed the trains are desired to run between stations; also on the construction of the line of rails between the point at which the local power is caused to cease its effort on the train and also on the distance a train is to run before it arrives at the next station. Or the local steam or other power may be caused to exhaust a suitable

vessel, in order that an atmospheric system of propulsion may be used to start, and for a time to propel, a train till it has arrived at the speed requisite to carry it to the next station without further requiring the local power to continue its action on the train.

The mode preferred of applying the proposed system to a line of railway may be thus described. Stationary engines will be erected at convenient positions, about three or four miles apart, and by an hydraulic main power will be laid on to accumulators at each station. The accumulator will be employed to propel a rope horizontally, in a manner similar to that used in hydraulic cranes to raise weights vertically; and the machine will be correctly described as an horizontal hydraulic crane, having the velocity of the piston increased by multiplying, so as to exert a force horizontally for a distance sufficient (without undue acceleration) to put into the train such an amount of power or *vis viva* as will be sufficient to propel it beyond the next station, so that the break is required to stop it. The length for which the propelling power is required to be applied will depend upon the distance and gradient between the stations, and will probably vary from 100 to 400 yards, and the machinery will require to be varied to meet each particular case, so that in long distances water-power engines, similar to those now used in goods sheds for propelling trains, may be a more advisable system for giving motion to the rope, such water-power engines acting in the same manner as stationary engines now used in propelling trains by ropes; or they may be used to propel by atmospheric pressure by exhausting air in a pipe. The carriages are proposed to be attached to, and detached from, the rope in the same manner as is now adopted in carriages detached from fast trains; or it may be found preferable to have a small propelling carriage attached to the rope, which would push a projection under the carriage, and would cease to act the instant the machinery was stopped without depending upon the guard of the train.

In constructing tunnels for railways, particularly where the tunnels are to pass under rivers or under towns and places where the upper surface cannot without serious injury be broken up or interfered with, a cylinder of somewhat larger internal diameter than the external diameter of the intended tunnel is employed, such cylinder being, by preference, of wrought iron or steel. The forward edge of this cylinder is made comparatively thin. Within this cylinder, and near the forward end thereof, are upright plates parallel to each other, also formed with forward cutting edges, in order to cut freely through the soil in front when the cylinder is forced forward. The earth is continuously removed from within this cylinder, and the cylinder is from time to time forced forward a short distance, to admit of a ring of iron being put together within the inner end of the cylinder, such iron rings being of a strength suitable for forming a permanent lining to the tunnel. It is desirable that the thickness of the iron of the cylinder should be as little as may be, in order that the space between the outer surfaces of the rings and the earth which surrounds them may not produce any subsidence in the surface of the land above.

The figure in Plate VI. shows a longitudinal elevation, partly in section, of a portion of a tunnel composed of a succession of rings of iron put together with screw bolts and nuts, and also of the cylinder

by and within which the work of removing the earth is performed. The cylinder is from time to time forced forward by screws, and the rings of the iron tunnel are then put together, whilst the surrounding earth is upheld by the cylinder. If the soil is weak, provision may be made for using poling boards, as is well understood. The space, as it is left between the earth and the exterior of the tunnel, may be filled by injecting or running in fluid cement.

To BENJAMIN GLOVER, *of Parker's-row, Dockhead, for improvements in carriage wheels and axles.*—[Dated 14th September, 1864.]

THIS invention has for its object improvements in the formation of the boss of the wheel in combination with improvements in the construction of the end of the axle, for the purpose of securing the wheel thereon.

In Plate V., fig. 1 shows a vertical section of the boss *a*, of a wheel mounted upon one end of an axle *b*, the parts being constructed and arranged in accordance with the improvements; fig. 2 shows one end of the axle or arm *b*, separately; fig. 3 shows an end view of the axle *b*, with the ring or "collet" *c*, thereon; fig. 4 shows the ring or collet *c*, detached; and figs. 5 and 6 show separate views of the locking plate *d*. The end of the axle *b*, has a circular groove b^1, formed thereon, other grooves or key-ways b^2, being formed at right angles thereto, so as to leave projections b^3, b^3, at the end of the arm *b*. The central opening in the ring or collet *c*, corresponds in form with the end of the axle, so that it can be easily slidden upon it; and when it has passed beyond the projections b^3, it can be turned round, so as to place the internal projections c^1, behind the projections b^3, the grooves or recesses b^2, and c^2, being thus brought opposite to each other into a position to receive the projections d^1, which form part of the locking plate *d*. The several parts so put together are secured by the central screw pin *e*, being screwed into the end of the axle *b*, the shoulder formed by the collet *c*, serving to retain the wheel securely upon the axle, which is covered by the screw cap *f*, screwed into the recess formed on the outer side of the boss *a*. Oil, for lubricating the axle, is introduced, when required, through the orifice a^1, which at other times is closed by a screw or plug.

The patentee remarks, that in the construction of wheels, according to this invention, for all kinds of road vehicles, no portion of the nave or stock projects beyond the line of the tyre, as is the case in ordinary wheels to the extent of from three inches, and in many cases considerably beyond, frequently causing collisions in passing other vehicles, and rendering wide vehicles almost useless for narrow streets and gateways. The ordinary mode of securing the wheel upon the axle by means of a collet or nut and linch pin involves the necessity of having a projecting nave, whereas by these improvements the wheel is secured to the arm by the collet *c*, and locking plate *d*, (without the aid of linch pins), thus greatly reducing the width of the parts, and rendering the projection of the nave beyond the line of the tyre of the wheel unnecessary.

The claim is "for the improved mode of constructing and com-

bining the parts of carriage wheels and their axles, for the purpose of securing the wheels upon the ends of the axles or arms, as described."

To Richard Richards, *of Wednesbury, Staffordshire, for certain improvements in carriage axles.*—[Dated 17th September, 1864.]

The object of the first part of this invention is to secure the bush upon the axle in a simpler manner than formerly, though in quite as effectual a mode. Hitherto a right and left-handed screw and a collet has been used, but it is proposed instead thereof to employ a single button. The bush is also tightened, as the leather washer in the collar wears away, by means of a slot with which the button is fitted, and through which slot a linch pin is projected when the bush is adjusted to its proper tightness.

The second part of the invention has for its object to make the collar of a reduced size, which is done by altogether dispensing with the usual inner flange, and instead thereof a perfectly flat bearing is provided for the axle. In this manner strength is given where it is needed, but at the same time no greater weight of metal is employed than is absolutely necessary.

The third part of the invention relates to the lubrication of the axle. Formerly the oil or other lubricating material has been supplied from the front of the nave, but an aperture is now constructed in the bush at the back of the wheel, and this being the highest point of the axle, the oil by its own gravity runs down into the cap and parts where it is required.

In Plate VI., figs. 1 and 2 show in section an axle and bush constructed according to this invention, and fig. 3 shows the improved spanner. *a*, is the bush fitting truly upon the axle *b*; it is screwed at *c*, to receive the cap *d*, and has at its other end a screw *e*, for the introduction of oil, and a recess *f*, into which the oil may run. *g*, *g*, are the usual feathers cast upon the outside of the bush. The shaft *b*, is formed square at one end as usual, and has a collar *h*, forged upon it, which is recessed, as shown, to receive the end of the bush *a*: a leather washer is interposed at *i*. The shaft has a groove *k*, extending along the top of that part which enters into the bush; this is for the purpose of supplying oil to all parts of the bearing surfaces. The shaft is screwed at *l*, and has a nut *m*, which prevents the axle from withdrawing from the bush. The button has a slot *n*, through opposite sides of it, and the shaft has a linch pin *o*, passing through it and through the slot of the button, and so the latter is prevented from turning; at the same time the slot allows of the linch pin being re-introduced after the button has been adjusted, to compensate for end wear.

In fig. 2 the collar *h*, upon the axle, enters into a recess in the end of the bush: in all other respects it resembles fig. 1.

Fig. 3 is a plan of the improved spanner. The improvement consists in making the internal shape of the end, as at *p*, circular, instead of hexagonal or octagonal. The cap *d*, to be moved by it, is also made circular externally, and has a hole *s*, in its flange (see fig. 1), into

which the pin *t*, of the spanner enters, and so affords the necessary holding power. The end *v*, of the spanner is for the purpose of turning the nut *m*, and may be also of the improved form.

The patentee claims, "First,—fitting and securing the bush upon the axle in manner described. Second,—so constructing the collar that strength is given where it is required, although the collar is considerably reduced in size, in manner described. Third,—lubricating the axle in manner described. Fourth,—the improved spanner, shown at fig. 3."

To OTTO GOSSELL, *of Moorgate-street, City, for improved apparatus for adjusting the weight of railway carriages and engines,—being a communication.*—[Dated 25th January, 1865.]

THIS invention relates to a novel arrangement of weighing apparatus to be applied to the wheels of railway engines and carriages, for the purpose of ascertaining the proportion which each of the supporting springs sustains of the gross load carried by the wheels and axles.

In Plate VI. the improved apparatus is shown in side elevation, as applied to a railway carriage wheel, for the purpose of raising it from the double-headed rail on which it rests. The apparatus may be described as a modified arrangement of steelyard. It consists of a rectangular casting, which forms at once a base plate and a standard for the weigh beam and steelyard arm. The horizontal portion A, of this casting terminates in a claw *a*, which, when the apparatus is applied to a carriage on a railway, rests upon the under head of the rail, or upon the foot, as the case may be. The vertical portion of the rectangular casting or standard A^1, is fitted near its upper end with a graduated steelyard arm B, along which a weight *b*, is capable of sliding. Jointed to this arm, and pendent therefrom, is a connecting rod C, which is jointed to the forked end of a lever D. This lever D, is fitted at its opposite end with a claw of steeled iron *d*, which, when the apparatus is in use, is intended to bear against the under side of the wheel tyre, and lift it clear of the rail. The lever D, is provided with a transverse knife edge d^1, which bears upon a divided saddle piece *e*, secured in dovetail vertical recesses in the sides of the base plate A, but capable of sliding therein. This knife edge d^1, forms the fulcrum on which the lever D, rocks when its longer limb is depressed by the action of the steelyard weight *b*.

To adapt the machine to different heights of rails a sliding wedge F, is employed. This wedge is forked, for the same reason that the saddle piece *e*, is divided, viz., to allow the claw end of the lever D, to drop sufficiently low for its knife edge to bear upon the face of the saddle piece. The forked end of the wedge F, passes under the saddle piece, or between it and the bed plate A, so that as the wedge is advanced or drawn back, the elevation of the saddle *e*, and consequently of the claw end of the lever D, is adjusted. The wedge F, is operated by a screw *f*, which is connected to its rear end so as to be free to turn. The screw *f*, passes through a tapped lug cast on the bed plate A; when, therefore, the screw is turned it will drive forward or withdraw the wedge as required, and thus adjust the elevation of the claw of the lever to the requirements of the case.

In like manner the elevation of the base plate above the ground is regulated by a screw jack arrangement G. By means of this adjustment a plummet g, attached to the upper end of the standard A^1, is made to coincide with a fixed gauge point g^1, and thus the proper vertical adjustment of the standard is determined. The steelyard arm has a knife-edge fulcrum as usual, and it is provided with an index b^1, which moves over a graduated segment face on the top of the standard. The connecting rod C, is forked at its upper end, to receive the steelyard arm, and a knife-edged pin (the knife edge being downwards) serves to couple them together.

In order to ascertain the strain upon the springs, for the purpose of equalizing the load upon the axles of a locomotive or carriage, one such apparatus as has been described is to be placed under each wheel, in such a manner that the claw of the base plate A, rests upon the foot of the rail, and the claw of the lever D, grasps the under side of the wheel tyre, having its fulcrum on the adjustable saddle piece e, of the base plate.

The apparatus being now so adjusted by means of the screw-jack arrangement C, that the plummet g, attached to the standard coincides with the gauge point, the wedge F, is to be pushed forward until the steelyard arm B, attains its normal position, which can be determined by the position taken by the index b^1, with respect to the figures on the curved scale on the top of the standard.

A weighing apparatus having been placed under each wheel of the locomotive engine or carriage, whose weight is required to be ascertained, and the steelyard arms of each having been brought into a corresponding position, the weights b, are to be placed upon the steelyard arms, and brought severally to such a position thereon that the marker of each apparatus will stand at 0. Each wheel must then be raised just clear of the rails, and the load of each separate wheel may be ascertained by referring to the scale marked upon the upper face of the steelyard arm. The greater or less difference in the results given by the different apparatus will show in the clearest manner the greater or less inequality of the load, and of the strain upon the springs of the different wheels, which strain can then be regulated with ease and certainty. The sum of these several weights will be the gross weight of the whole engine or carriage.

In order to secure the apparatus in position when used in connection with a double-headed rail, a rock lever H, is fitted to the underside of the platform. This rock lever terminates in a claw, which is inserted below the rail, and is caused to bind tightly against the under rail head by means of a pressing screw, which passes through the platform, and bears on the rear end of the rock lever. When, however, the weighing apparatus is applied to flat-bottomed rails, this moveable claw will not be required.

The patentee claims, "the arrangement of apparatus above described for ascertaining the proportion of weight which each supporting spring of an engine or carriage sustains, and thus to adjust the gross weight upon the springs with ease and certainty."

To Richard Chrimes, *of Rotherham, Yorkshire, for improvements in hydrants or fire-cocks.*—[Dated 17th September, 1864.]

This invention consists in the employment of a small valve in combination with a sluice valve in such a manner that when the sluice valve is open, and the hydrant or fire-cock in use, the small valve will be shut, and *vice versa.*

The figure in Plate VI. represents a side elevation and partial section of a hydrant, having the improvements applied thereto, and connected to a fixed street-watering stand post, the sectional portion showing the hydrant valve closed, and the post valve fully open; the stand post and hydrant being in consequence completely empty, and therefore not liable to injury from frost. A, is the street stand post, provided with the usual screwed nozzle at B, for the attaching of a hose; C, is the hydrant elbow, to which the stand post is secured in any well-known or other convenient manner. The communication between the elbow C, and the main or other water-supply pipe at D, is opened or closed, as required, by the sluice valve E, operated upon in the usual manner. On the back of this sluice valve there is formed a small projection *a*, which, after the orifice of the sluice valve is closed, and before such valve is completely home in its seat, presses upon the tail of a short lever *b*, the opposite end of which is connected with the frost valve *c*, situate between the sluice valve and the stand pipe, and opens such frost valve so as to allow the stagnant water in the hydrant elbow and stand post to flow off after the sluice valve has been closed. The projection *a*, is so placed with regard to the lever *b*, that the sluice valve will be actually closed before the frost valve *c*, is opened, whilst, on the other hand, the frost valve *c*, will be closed by its own gravity before the sluice valve is opened; there being sufficient play in the sluice valve after its orifice is closed to permit of the opening of the frost valve. It will thus be seen that by this arrangement it is impossible to place the valves in such a position that both will remain open, which position would cause an unnecessary waste of water through the frost valve. *d*, represents a screwed nozzle, to which a pipe may be fitted for carrying off the waste water from the frost valve into a drain or sewer. Precisely the same combination of sluice valve and frost valve, with the means for opening and closing the same, can be comprised in other arrangements of hydrants.

The patentee claims, "the application and use of a small supplementary frost valve, combined with, and operated by, a sluice valve, in such a manner that the frost valve shall be opened after the orifice of the sluice valve is closed, and closed before the orifice of the sluice valve is opened, substantially as described."

To Joseph Smith, *of Bradford, Yorkshire, for improvements in machinery or apparatus for spinning and winding wool or other fibrous materials on to spools and tubes.*—[Dated 17th September, 1864.]

This invention consists in preventing the unravelling of the worsted or other material, and to obtain a better drag or tension upon the yarn

or thread while being wound upon the spools or tubes in what are called cap frames.

In Plate VI., fig. 1, represents the improvements in vertical section as applied to a spindle. *a*, is the ordinary cap; *b*, the conical ring threaded on the inside to screw on to the cap, which is threaded externally; *c*, is the spool, *d*, the tube, and *e*, the whorl; the ring *b*, is formed with a flange or enlargement at bottom, to keep the yarn from coming in contact with the side of the cap *a*. The ring *b*, can be raised on the cap *a*, when using fine threads, in order to diminish the drag or tension, or it may be placed below the cap if required. The bottom of the cap is contracted, as shown at *f*, to prevent the thread revolving against the inside of the cap. As the thread is wound upon the spool *c*, the whorl tube and spool are raised and lowered in the ordinary manner: the spool *c*, is inverted, as shown.

Fig. 2 is a vertical section of an arrangement in which a ring *g*, with a flange *h*, is screwed inside the mouth of the cap *a*: the ring *g*, takes the place of the projection *f*, and the flange *h*, of the conical ring *b*, in fig. 1. By raising and lowering the ring *g*, with its flange, the drag will be regulated.

The patentee claims, "First,—constructing the caps of cap frames with external screw threads, or other means, for receiving a conical ring or other projection, or forming an external ring or other projection in a piece with such caps, substantially in manner described. Second,—constructing caps of cap frames with the entrance or mouth contracted, in manner described. Third,—the arrangement represented in fig. 2."

To RICHARD ARCHIBALD BROOMAN, *of Fleet-street, for improvements in the manufacture of phosphuret of iron, phosphate of lime, and alkaline phosphates,—being a communication.*—[Dated 19th September, 1864.]

THIS invention mainly consists in a process for transforming fossil phosphates into phosphates of soda or of lime commercially pure. If silica, iron, and coal be added to phosphate of lime, the proportions of these several substances being combined in such manner that the silica can form with the lime a fusible silicate, and that the coal be in sufficient quantity to reduce the phosphoric acid of the phosphate, and if the mixture be submitted to fusion for four or five hours, there will be obtained phosphuret of iron and scoria or dross.

In the nodules or lumps of fossil phosphate of lime, there are, in addition to the phosphate, silica and oxide of iron; generally the latter is not in sufficient quantity, and it is necessary to add more. The quantity of phosphorus which the nodules contain is ascertained by previous chemical analysis, and a quantity of iron representing three and a-half times the weight of the phosphorus is employed: account must be taken of the amount of iron which the nodules already contain, and then there should be added only what is required to make up the quantity above-named.

The operation may be easily performed in a blast furnace, such as is used for making cast-iron. The only difference between the two opera-

tions is, that in the present case it is necessary to put into the furnace alternate layers of fuel nodules, either whole or roughly crushed, and iron, the quantity of which is determined as above-mentioned. The iron may be replaced by cast-iron or by an oxide of iron, account being taken of the oxygen of the latter. The phosphuret of iron thus obtained may be run into ingots, but generally it will be found advantageous to terminate all the operation at once. The phosphuret of iron in fusion on its exit from the blast furnace is brought directly upon sulphate of soda previously heated; sulphate of soda may also be heated to redness in a reverberatory furnace similar to an ordinary soda oven, and the phosphuret of iron in fusion poured upon it, or the phosphuret of iron may be reduced to a granular state, and pulverized soda mixed with it, and the mixture heated in a reverberatory furnace; the reaction is very quick, and may be explained thus:—The phosphuret of iron decomposes the sulphuric acid of the sulphate of soda, combines with its oxygen to form phosphoric acid, while the reduced sulphur combines with the iron; the phosphoric acid unites with the soda, and a portion of the iron passes also into the state of peroxide at the expense of a certain quantity of sulphuric acid of the sulphate of soda. The solid mass resulting from this operation is therefore composed of phosphate of soda, sulphate and oxide of iron; there are also small quantities of free soda, sulphuret of sodium, sulphate of soda in excess, but in very minute proportions. The mixture is submitted to washings to remove all the alkaline phosphate, which may be afterwards crystallized. The residue is composed of sulphuret and oxide of iron. The sulphuret of iron may be utilized by leaving it in heaps exposed to the air, and sprinkling them occasionally with water. It is thus transformed into sulphate of iron, which may be lixiviated and crystallized. The oxide of iron which remains after this last operation may be used in a fresh production of phosphuret of iron.

Instead of obtaining phosphate of soda by crystallization, it is sometimes more economical to precipitate the aqueous solution of this salt by a milk of lime; phosphate of lime is thus produced, which is washed and then dried; the liquid and the wash waters contain all the soda which was in the phosphate of soda: this alkali may be obtained by evaporating to dryness; or if it is found more advantageous, this alkali may be saturated with carbonic acid, and then concentrated to produce crystals of soda or salts of soda.

The sulphate of soda may be replaced by the following salts:—Sulphate of potassa, bisulphate of soda or of potassa, azotate of soda or of potassa.

All natural and artificial phosphates, with a base of lime or iron, may be treated in manner before described.

Among other applications, the phosphuret of iron may be used for the production of phosphorus; for this purpose it is sufficient to submit it to quick redness under the action of sulphur, sulphuretted hydrogen, sulphuret of carbon, or sulphurets capable of yielding a part of their sulphur, such as metallic bisulphurets and alkaline polysulphurets.

The patentee claims, "the manufacture of phosphuret of iron, phosphate of lime, and alkaline phosphates, substantially in manner described."

To CHARLES FERDINAND METKE JESSEN, *of Robert Town, near Normanton, Yorkshire, for improvements in processes for treating, softening, and preparing silk waste or pierced cocoons, which improvements are applicable to the treatment of other descriptions of fibrous materials.*—[Dated 20th September, 1864.]

THIS invention relates, first, to improvements in the processes employed when treating silk waste of various descriptions, or "pierced cocoons," for the purpose of dissolving the gummy matter which adheres to the silk so that the fibres will freely split and separate, ready for the subsequent process of combing, dressing, and spinning.

The process usually employed for softening silk waste and pierced cocoons consists in closely pressing the same into large vessels, of wood or stoneware, filled up by preference with hot water, the temperature of which is kept up for a considerable time, varying from eight to ten days, or until the silk waste thus treated becomes soft and will split or separate, ready for being combed or dressed.

The improved process is to immerse the silk waste or "pierced cocoons" in a vessel containing water, soap suds, or an alkaline solution (by preference warm), according to the nature of the silk waste to be treated; streams of air being forced through the liquid in any convenient manner, in order to agitate the same during the process. A number of hard balls of wood are introduced into the vessel, to impart friction to the materials whilst under operation.

For the treatment of some descriptions of silk waste, clear water alone may be employed, or the waste soap liquor which has been previously employed for boiling or scouring purposes may be used in place of being thrown away. When the silk waste thus treated is sufficiently soft, it is washed in cold water, agitated, as previously described, by forcing streams of air through the liquid, to remove the loose particles of gum, after which it is dried and worked in the ordinary manner, after being softened. By thus treating the silk waste a good yellow colour will be obtained, and a longer and stronger fibre will be produced, with less waste in the subsequent processes. The process above described is applicable to the discharging of silk waste or cocoons as a preparatory process for rendering silk white, in place of the process usually employed for this purpose. The silk waste is first agitated, by streams of air as before described, in a vessel containing water, or, by preference, soap suds or an alkaline solution, and afterwards with clean water, and only requires once boiling afterwards to produce a clear white; a great saving of soap is thus effected, a stronger and more brilliant fibre being also obtained with much less waste in working than by the ordinary process of boiling only for rendering the silk waste white.

Other fibrous substances, combined with gummy or other foreign or resinous matters, may also be treated as above described, for the purpose of softening, separating, and preparing the same for being afterwards combed or dressed, as is well understood; or the above described process may be advantageously employed in the treatment and preparation of rags or other fibrous materials, to cleanse and prepare the same for the manufacture of paper, or for other manufacturing purposes.

To Edward Thomas Hughes, *of Chancery-lane, for an improved fan to be employed for ventilating and other purposes,—being a communication.*—[Dated 21st September, 1864.]

The improved ventilating fan is shown in partial sectional elevation in Plate VI. The case of the fan is composed of two parts bolted together in horizontal lines central with the shaft *a*; D, E, representing the diameter of the fan, and *c*, *c*, *c*, one of the side holes for the supply of air. The shaft revolves in bearings fixed to the frames *b*, which are cast with the lower part of the case. The wings shown at A, A, are of a curved form, and two in number, but a greater number may be used when desired.

The wings start from bosses on the shaft, in order that the air which passes through the air holes shall gradually increase its speed as it is gliding towards the extremities of the wings, and thereby considerably augment the suction and blowing power of the fan, and at the same time materially lessen the dull noise common to ordinary fans. To lessen the sound caused by the air entering the case, a partition may be fixed in the middle of each wing, so that the two currents of air entering the sides of the case may not come in collision with each other. This improved fan may also be constructed to produce a single or double effect; when single, there is only one exit hole for the air, X, Z, being the entrance of the exit pipe B. To have a double effect there must be two exit holes for the air, the hole X, Z, and the hole E^1, F^1, which is the entrance of the pipe B^1, and the pipes B, B^1, may finally conduct to another single pipe the air they receive from the wings.

By this double simultaneous exit of air from the fan a double quantity of air can be obtained without enlarging the diameter of the wings, or requiring much additional power. It will be seen that in the fan of double effect the upper part of the case is larger to the extent of E^1, F^1, than the upper part D, E, of the single fan, and that it has the additional passage E^1, F^1, B^1, placed at the outside of the lower part of the case.

The patentee claims, "First,—the curvature of the wings, and causing the said wings to spring from, or have their roots in bosses fixed to the shaft of the fan. Second,—the double exit air pipes. And, Third,—the general arrangement and construction of the apparatus described."

To Archibald Henry Plantaganet Stuart Wortley, *of Rosslyn House, Grove End-road, and the* Honourable William Warren Vernon, *of Rutland Gate, Hyde-park, for a new chemical process for producing photographic pictures, and in the preparation and manner of using the materials in such process,—being a communication.* —[Dated 24th September, 1864.]

This invention consists, first, in preparing photographic paper by bringing the fibrous material of which the paper is composed into actual contact with the compounds or simple agents used as mediums for coating such papers, thereby producing a better, smoother, and more even surface. Second, in producing on photographic paper a

"matt" or "dead" surface, instead of a smooth or glazed surface, so that when pictures are printed on such paper they will have a mellow and quiet effect. Third, in a new chemical compound for rendering photographic paper or other materials highly sensitive, and in being able to print photographic pictures on paper or other material to the actual intensity (in colour) required, doing away with the necessity of over-printing and allowing for the reduction of intensity of colour in the bath, as is now the case.

The following are examples of the means by which these improvements in photography may be effected.

As regards the preparation of photographic paper or the surfaces of any other material capable of receiving an impression by the action of light, the patentees take paper, expressly made for photographic use, and cover it with any of the well-known simple mediums, such as arrowroot or common starch, albumen, in combination with any other compound or simple material suitable for any special purpose, and instead of merely enveloping the surface with the solution, and then allowing it to be naturally absorbed, which will furr up the surface of the paper, and merely deposit itself between the fibre (as is now the case), and when dry prevent the fibre of the paper from properly interlocking, they first envelope the surface of the paper with the solutions as before described, and either place it under pressure between two polished surfaces or subject the paper to a rubbing process by any material best suited to force the medium into and between the fibres, and lay them in a firm and compact manner, to produce, when dry, a smooth surface; or they pass the paper between rollers especially constructed to effect the purposes herein specified,—the great and important object being to incorporate the fibre of the paper with the medium, and then to lay down and interlock the fibre again after being fully charged, so that when dry and prepared it will have a better surface for the production of photographic pictures.

The next novelty in photographic chemistry and manipulation is in rendering the surface of such paper or other materials highly sensitive to the action of light for the production of pictures from and through the negative to the positive. The patentees take collodion prepared by any of the well-known methods, to which may be added any of the gums or other mediums to produce elasticity, flexibility, and adhesiveness; and add, say, to one pound of collodion so prepared from 1½ ounces to 3 ounces (or even more) of the nitrate of uranium, and 20 grains to 2 drachms of the nitrate of silver. When the solution is thus rendered sensitive, the paper is prepared by pouring the sensitive solution on to the surface, and then floating it in the ordinary way, the superfluous quantity being poured off the paper; it is then hung up in a dark room to dry, when it is ready for the printing-frame.

The sensitive collodion thus prepared and combined has the following advantages over the old process, viz., that instead of having to print the positive to a greater intensity of colour to allow for its reduction in the bath, as is now the case, the picture may be printed from the negative on to the positive paper, up to its proper strength of colour, such as in appearance will be satisfactory to the operator. After immersion in a bath of acetic acid or any other agent in solution, to dissolve the salts, which are unaltered by the action of light (which

takes by this process about from ten to twelve minutes), the picture is placed on a sheet of glass under a stream of water, and rubbed with a brush or sponge, or passed through a series of baths until it is perfectly clean. The picture is then submitted to any of the so-called toning baths, containing chlorides of any of the superior metals; or the hyposulphite bath may be used or not, as may be required by the operator, to produce any tone of colour he may think best suiting his taste.

To obtain a photographic picture, the effect of which will be what is technically termed a "matt" or "dead" and not glazed appearance, instead of dissolving the sensitive salts in collodion as before described, they are dissolved in alcohol and water, and any saccharine substance which is needed is added. The paper is then prepared by covering it with the alcoholic and water solutions, combined with the chemical salts to render the paper sensitive. The paper thus prepared is hung up in a dark room to dry, when it is also ready for the process of printing by the action of light.

The patentees claim, "First,—the manner of preparing photographic paper or other materials as herein set forth. Secondly,—the using of the nitrates of uranium and silver in combination, by which a new salt is produced, and using them so combined with the mediums herein specified for the production of photographic pictures in their development at one operation, as fully set forth."

To GEORGE COLES, *of Gresham-street*, JAMES ARCHIBALD JAQUES, *and* JOHN AMERICUS FANSHAWE, *both of Tottenham, for improvements in the manufacture of boots, shoes, and other coverings for the feet.*— [Dated 10th February, 1865.]

THIS invention relates to an improved mode of making the soles and heels of boots and shoes, and consists in forming them of a combination of hard and soft rubber compound, combined with any suitable textile fabric, in place of leather, as is now usually employed.

A blank, or piece of the size and shape of the sole, or sole and heel combined, is first stamped or cut out of a sheet of hard rubber compound, and, either at the same time or aftewards, small pieces are cut out from this blank, of a round, oval, rectangular, or other convenient shape, and in the openings so formed are introduced pieces of soft rubber compound, so as to make up the sole complete again, but consisting of a skeleton or framing of hard rubber compound, combined with internal pieces of soft rubber compound.

In Plate VI., fig. 1 represents one of these improved soles, composed of hard and soft rubber. The hard rubber skeleton is shown at *a*, *a*, and the soft rubber compound at *b*, *b*.

A thickness of soleing having been thus produced, is covered on one or both sides with any suitable textile fabric, such as canvas. Another thickness of compound soleing is then placed thereon, and, if deemed desirable, two or more thicknesses may be added, with or without textile fabric between them, so that the sole, when complete, will consist of alternate layers of hard and soft rubber compound, with or without textile fabric between them. The sole or piece so combined is then "cured" by heat in the usual manner, to produce the change

known as vulcanizing, and may then be employed in the manufacture of boots and shoes in place of the ordinary sole leather. The difference in hardness between the two parts of the sole thus produced will give a good firm hold to the foot, and will prevent it from slipping. The hardness of the skeleton framing will also protect the softer parts from undue wear and tear.

The improved soleing may be adapted to boots and shoes made in the ordinary manner, which may be clumped by attaching the improved soleing to the leather soles of the ordinary shoes or boots, either by means of pegs or screws, or by means of india-rubber cement; but where clump soles are not always required, the soleing may receive an "upper," to allow for temporary attachment to a boot or shoe, as shown at fig. 2. The boot or shoe will thus be goloshed, but the improved golosh may be readily removed. Fig. 3 represents another method of temporarily attaching one of the improved soles to a boot. In this instance only a sole is employed, and it is held on the boot by an elastic band *c*, which passes behind the heel. Fig. 4 represents another mode of temporarily attaching one of the improved soles to a boot. In this case the band *c*, is dispensed with, and the upper of the sole is provided on each side with a button hole or stud hole *d*, and the boot is provided on each side near the waist with a stud or button, on which the sole is hooked by the holes *d*.

The patentees claim, "constructing the soleing of boots, shoes, and other coverings for the feet, in the manner set forth."

Scientific Notices.

MECHANICAL ENGINEERS' SOCIETY.

(*Continued from page* 116.)

The following paper, "*On the principal seams of coal and ironstone in the Glasgow coalfield,*" was read by Mr. WILLIAM MOORE, of Glasgow.

General Description of Coalfield.—The valuable seams of coal and ironstone in the Glasgow Coalfield are situated in the counties of Lanark, Stirling, Dumbarton, Renfrew, and Linlithgow, and lie between the New Red Sandstone and the Hurlet Coal. They are divided into an upper and a lower series of minerals: those seams lying above the Garnkirk or Caulm limestone of Garnkirk and Bedlay form the upper series; and those lying under the Possil or Cowglen limestone form the lower series.

The most valuable seams of coal lie above the Garnkirk or Caulm limestone in the upper series; and the principal seams of ironstone lie under the Possil limestone in the lower series of minerals. It is from the upper series that the coals have been taken for the supply of household, manufacturing, and iron smelting purposes, during almost the

whole history of the coalfield; and the principal seams in this series are collectively known as the Glasgow and Monkland seams, extending over an area comprising about 37 square miles, more or less interrupted by faults, bounded by Bathgate and Morningside on the east, by Carluke, Hamilton, and Quarter on the south, by Glasgow on the west, and by Gartsherrie and Jawcraig on the north.

The main supply of ironstone for the use of the Scotch ironworks comes from the two Possil ironstones, the two Garscadden Blackband ironstones, and the Dalry Blackband ironstone.

Detailed Description of Coal Seams.—The Upper coal is that from which Glasgow was in former years supplied with the best quality of household coal. This seam is in its best condition, both in thickness and quality, near Glasgow, Rutherglen, and Stonelaw. It gradually gets inferior as it goes eastward, and thins out altogether in the mineral fields near Coatbridge and Baillieston.

The Ell coal is the seam from which at present the largest quantity of coal for household purposes is derived, and which now contributes so largely to the supply of Edinburgh, Glasgow, and the north of Scotland. The most valuable deposit of this seam is in the neighbourhood of Wishaw and Motherwell, extending along the line of the Caledonian Railway nearly as far as Carluke, and on the line of the Lesmahagow branch within a short distance of Auchenheath. The thickness of the seam, which is not more than 4 feet at Glasgow and 2 feet at Baillieston, gradually increases towards Wishaw to about 11 feet. In the district adjoining Wishaw the quality is of the first class, and the coal is used chiefly for household purposes. In some of the collieries to the east of Wishaw the coal is of a slightly burnt description, and is used for steam purposes. There is still a considerable area of this seam to work, lying on the line of the railways already mentioned; in the locality immediately adjoining Wishaw, however, it is very much exhausted. So great has been the demand for this quality of coal, that within an area of about three square miles in the Wishaw district there are as many as twenty-five collieries working almost wholly on this Ell coal seam.

The Pyotshaw and Main coals are sometimes apart a distance varying from 6 to as much as 24 feet, as at Baillieston and Coatbridge. At Drumpeller and Wishaw they are together, forming one seam, about 9 feet in thickness. The Pyotshaw coal sometimes contains a thin gas coal, varying in thickness from 4 to 10 inches: at Springhill, near Baillieston, this gas seam is of fair quality, and is supplied to the Glasgow gas works. The Pyotshaw and Main coals are hard coals, containing rather too much ash for household use, so that they are used chiefly for iron smelting and forge purposes.

The Humph coal is a thin seam of not much value. It has been worked at Dalmarnock, near Glasgow, and at Coatbridge, for furnace purposes and for calcining clayband ironstones.

The Splint coal is that which has been so long used in the manufacture of iron in the Coatbridge district. It is a hard coal of excellent quality, and in the Monkland district is very nearly exhausted. At Wishaw, and in the district towards Hamilton, it is entire; but it has been found very expensive to work, on account of having a soft shale roof. This seam of coal is usually accompanied by a thin band of clay

ironstone, varying in thickness from 3 to 4 inches, which is worked in connection with the coal. At Bredisholm, near Baillieston, this seam becomes a gas coal, and is worked as such to a considerable extent for the supply of Glasgow and for Irish consumption.

The Wee coal is a good household coal, and is extensively worked as such in the Baillieston district for the supply of Glasgow. The collieries working this seam lie principally along the line of the Monkland Canal, by which the coal is conveyed to Glasgow and other parts of the Clyde.

The Virtue Well coal is essentially a Monkland coal. It is found best in the neighbourhood of Airdrie and Coatbridge, and is used principally for household purposes. In some of the collieries near Airdrie the coal is burnt, and is used for steamboat purposes. In the eastern part of this seam, extending to Slamannan, it is called the Johnstone coal, where it is of a coarser quality, and is used for household purposes.

The Kiltongue coal is worked in the neighbourhood of Coatbridge and Airdrie, at a thickness of about 2½ feet. At Drumpeller it is 6½ feet thick, and is used for household and forge purposes. In the Redding and Slamannan districts this seam is called the Splint coal; and at Slamannan it is one of the most valuable of the Scotch steam coals, and brings the highest price on the Forth and Clyde for this purpose. At Redding the coal changes its character, and becomes a hard splint coal suitable for iron smelting purposes. Above the Splint coal at Slamannan there is a seam known as the Lady Grange seam, about 2½ feet thick, worked chiefly for household purposes. At Calderbraes, in the position which the Kiltongue coal would occupy, there is an ironstone called the Calderbraes ironstone, about 8 inches thick.

The Drumgray coal is known in the Redding and Slamannan districts as the Coxrod coal. In the Airdrie and Coatbridge districts this seam is a hard furnace coal; in the Redding and Slamannan districts it is a household coal of very superior quality.

The Lower Drumgray or Lower Coxrod coal is a seam worked for household purposes; it is usually thin, however, and is not generally much worked.

Besides the seams above described, which are collectively known as the Glasgow and Monkland seams, there are also several minor seams of coal in the upper series; namely, those of the Bathgate, Grangemouth, and Netherwood districts; and in the lower series, the Possil, Kilsyth, Kirkintilloch, Cowglen, Titwood, Hurlet, Campsie, Duntocher, Milngavie, Auchenheath, and Lesmahagow coals. These seams, however, are chiefly local, worked only in the immediate districts in which they are found.

The Bathgate seams are all of such an inferior quality that they are not even worked for the supply of the immediate district. The coal used in Bathgate is principally brought from the Monkland or from the Wishaw coalfield.

The Grangemouth coals are geologically the same as those at Redding, but are a little thicker, and the seams are more numerous. In point of quality, the coals are not equal to those of Redding and Slamannan. The collieries, however, have the advantage of being near the shipping port of Grangemouth, requiring little railway carriage,

so that the inferior quality of the coals is compensated for by their cheapness, and the colliery proprietors are enabled to ship a considerable quantity of coal. The Netherwood coals are coking and smithy coals lying immediately under the Caulm limestone.

The Possil seams of coal lying in proximity to the ironstone seams are worked mainly for the supply of workmen's fires and engine fires at the collieries, raising the ironstone. The Kilsyth coals are of a coking description, and are converted into coke at the collieries for the supply of Glasgow. The Kirkintilloch coals are generally steam coals.

The coals of Hurlet, Campsie, Duntocher, and Milngavie are inferior, and are used for steam purposes in those districts. The Lesmahagow and Auchenheath coal is used for the production of gas, and is the most valuable of Scotch cannels.

Detailed Description of Ironstone Seams.—The Palacecraig Blackband ironstone is a seam of inferior quality, very poor, and yielding only a poor percentage of metallic iron. It has been worked only by the Gartsherrie Iron Company at Palacecraig, near Airdrie. It extends over a large area in the Coatbridge district, but its quality has never been found such as to warrant its being much worked.

The Airdrie Blackband ironstone may be said to be almost wholly exhausted. It was upon this seam that the majority of the ironworks at Coatbridge were founded. It was discovered by the late Mr. David Mushet about the beginning of the century, and was highly valued for its freedom from deleterious impurities, and for the quantity of carbonaceous matter which it contained.

The Soft Blackband ironstone resembles the Palacecraig ironstone in point of quality. It was worked near Airdrie, but was abandoned on account of its inferior quality.

The Cleland Roughband ironstone is peculiar to the mineral field around Cleland. It is a clayband, yielding about 1000 calcined tons per acre.

The Bellside ironstone is found and worked in a limited area near Bellside, about 1½ mile south east of Newarthill. It is a black band ironstone of good quality, and worth about 16*s.* per ton at the Coatbridge works. The most extensive working of this seam is at Greenhill, in the parish of Shotts.

The Calderbraes ironstone is a band lying in the position of the Kiltongue coal, but not extending over a large area. It is worked at Faskine, near Airdrie, and at the Calderbank Iron Works. There is a thin gas coal in connection with the seam, which has recently been used for the production of paraffin oil.

The next seams are the Slaty bands of ironstone, which are the only seams lying in the upper series of minerals that are likely to yield a supply of blackband. The geological positions of these seams extend over an area equal to 30 or 40 square miles, a large part of which, however, is wholly unproved, while an equally large part has been proved to contain nothing beyond the mere position of the seams, the ironstones themselves being found to have thinned out. Both in thickness and quality these seams are exceedingly variable, measuring in some places as little as 4 inches thick, and in others as much as 3 or 4 feet. In its best state the quality of the ironstone is nearly equal to the Airdrie blackband; while at many places to the north of Airdrie

it contains so large a proportion of sulphur as to render it quite unfit for iron-making purposes. These bands of ironstone have been mostly worked at Bathgate, Crofthead, and Shotts. There are three slaty bands of ironstone as proved at Arden. The first of these is about 7 inches thick, and is supposed to be the same seam as that worked at Garbethill, Todsbughts, Cameron Glen, and Arden. The second or mid slaty band is about 15 inches in thickness, and is supposed to be the same ironstone as that found at Stepends, Crofthead, Armadale, and Shotts. The third band ranges in thickness from 7 inches to 4 feet, and lies in the same position as the seam at Goodockhill. In the neighbourhood of Bathgate the mid seam lies in connection with the famous Torbanehill coal, so highly valuable for the production of paraffin oil.

The next valuable seams of ironstone are those lying under the Possil or Cowglen limestone. The first of these are the Possil ironstones, two seams of excellent quality, the first of which is about 14 inches thick, and the second about 10 inches, both lying in connection with thin beds of coal, which conduces much to economy in working them. These two seams of ironstone extend over a large district, and generally maintain a regular thickness. Under the lowest of them lies the Govan gas coal, occupying the same position as the Lesmahagow and Knightswood gas coal. The quality of this coal is best, and it is worked most extensively at Lesmahagow.

The next seam is the California Clayband ironstone, of good quality, and worked at Kelvinside, to the west of Glasgow.

The Upper ironstone of Garscadden is the next seam; it is a blackband of first-rate quality, varying from 8 to 14 inches in thickness.

The Lower ironstone of Garscadden is very much of the same quality as the preceding; it varies in thickness from 4 to 14 inches.

The Garibaldi Clayband ironstone underlies the last-mentioned seam, averaging 14 inches thick.

The Dalry or Johnstone Blackband ironstone lies under the preceding seams, varying from 10 to 18 inches in thickness.

The ironstones worked at Comrie, Oakley, Inzievar, Cowdenbeath, and Lumphinnans in Fifeshire—Kinneil, Grange, and Balbardie, in Linlithgowshire—Croy, Banton, Kilsyth, and Kirkintilloch, in Dumbartonshire—Dolphingstone, Tranent, and Wallyford, in East Lothian—Dryden, in Mid Lothian—Johnstone and Paisley, in Renfrewshire—Muirkirk and Dalry, in Ayrshire—Possil, Garscadden, Kenmure, and Cadder, in Lanarkshire—correspond in position with the ironstones lying under the Possil or Cowglen limestone.

Between the Dalry blackband ironstone and the Hurlet coal there are numerous clayband ironstones; but with the exception of one or two which have been partially worked at Hurlet there are none workable. In the position of the Hurlet coal itself there is sometimes found a band of ironstone, as at Easterhouse, near Carnwath; but it is usually so contaminated with sulphur as to be quite unsuitable for iron-making purposes.

Fitting and Working of Collieries.—The depth at which the seams of coal and limestone are usually found varies from 20 to about 400 yards. The pits in the neighbourhood of Glasgow reach the Splint

coal at from 140 to 180 yards, and at Baillieston it is reached at from 140 to 250 yards. At Wishaw the pits seldom exceed 120 or 140 yards to the Ell coal. The deepest pits sunk in the district are the Nitshill Victoria pit, near Hurlet, sunk 350 yards to the Hurlet coal, about 5 miles south-west from Glasgow; and the Snab pit, at Kinneil, sunk 396 yards to the Eastermain coal. Some of the pits at Possil and the neighbourhood are sunk considerably more than 200 yards to the Possil ironstone.

The shape of the pits in plan is generally oblong, varying in size from 10 by 5 feet to 20 by 6 feet, according to the size of pumps to be put in the shafts. These shafts are usually divided into two compartments,—a space of 4 or 5 feet at the rise end of the shaft being kept solely for the purpose of the upcast shaft, and the remaining distance divided for the pumping and winding arrangements. The upcast shaft at one end is 4 feet wide, and the pumping shaft at the other end 5 feet wide, while the centre portion, 9 feet wide, contains two sets of winding gear. The brattice or midwall is made of planks of red pine cut to the width of the pit, 9 inches deep and 3 inches thick, let into the wall on each side of the pit, and made air-tight by corner rackings of wood, cut out of timber about 6 inches square. The slides for the cages are of red pine, usually 5 inches square. The needles or buntings for securing the slides are usually cut to a section of about 9 inches by 3 inches, and are placed in the shaft about 9 feet apart.

There is not generally much water in the Scotch collieries. The usual size of the pumps varies from 8 inches to 16 inches diameter of the rising main; and when the latter size is not exceeded, the rods are usually worked by bell cranks driven by a horizontal engine with crank and flywheel. Of late years where the diameter of the pipes has exceeded 16 inches, direct-acting engines have been adopted, with the cylinder placed vertically over the pumping end of the pit. The usual length of the lifts or sets of pumps is from 90 to 100 yards.

Only two systems of working coal are employed in the district: that of "Stoop and Room," and the "Long Wall" working.

The Stoop and Room system is much the same as that known in England as the "pillar and stall." As adopted in Scotland, it is customary to proceed with the working, leaving pillars or "stoops" containing about 55 or 60 per cent. of the coal for supporting the roof, until the pit has reached the limit of the area which has been laid out for working. The back working is then commenced, which consists in driving "rooms" through the stoops or pillars situated to the rise and on the level, leaving only the four corners of the pillar. These corners are usually 6 to 8 feet square, and are left in the pit permanently, and consequently are lost to the coal proprietor. The proportion of coal taken out of the field by this system varies from 70 to 85 per cent. of the total quantity of coal in the field. Seams of coal above 4 feet in thickness are usually worked by this method.

The Long Wall system is that usually adopted for working seams of coal under 4 feet in thickness and all seams of ironstone, and by it the whole of the coal or ironstone is taken out of the pit. The working faces are carried forwards continuously from the shaft towards the rise and along the level on each side; and for the purpose of

bringing away the coal as the working faces advance, packed roads are constructed through the goaf, by building up parallel walls of stone to support the roof, which are constantly carried forwards as the work advances.

The underground haulage is usually conducted by horses drawing on roads going along the level course of the seam. The rails employed are of cast-iron, of an angle shape, about 4 inches deep in the side, cast in lengths of 4 feet, and weighing about 60 rails to the ton. The gauge to which they are laid is usually about 2 feet 10 inches, and each end of the rail is spiked to a larch sleeper, 6 inches broad by 2½ inches thick, costing 1½*d.* to 2½*d.* each. The haulage of coals from dip workings is accomplished by means of stationary engines placed underground, and supplied with steam from boilers at the surface. The steam is carried down the upcast end of the shaft in pipes, and the exhaust steam from the engine is conveyed about 20 feet up the shaft in pipes, and then discharged to assist the ventilation. In some cases, however, the plan of letting the exhaust steam escape into the shaft has been found to injure the walls of the pit, by loosening the strata; and in recent fittings it has been deemed advisable to convey the steam the whole distance up to the surface in pipes.

The dip and rise of the strata in the district varies from 1 in 10 to 1 in 3. When the inclination is so steep as 1 in 3, the minerals are lowered from the rise workings by self-acting inclines with a chain and a horizontal pulley at the head of the incline. The pulley is usually about 3 feet in diameter, and the chain for lowering the wagons is passed twice round the pulley, to prevent slipping. The brake is applied to a friction ring cast on the side of the pulley.

The Scotch collieries cannot be said to be fiery: in few cases, indeed, are safety lamps required in working. Each pit has its fireman, who goes round the working faces of the pit each morning before the men proceed to work, to certify that all are free from fire. There are seldom any accumulations of gas except in places wholly shut off from the air current. In the "stoop and room" working, the stoops or pillars are almost invariably turned without the assistance of face brattices. The usual method of conducting the air current is to split it at the pit bottom and lead it round the working faces, and back to the upcast end of the shaft by the heading drift driven straight to the rise from the pit bottom. The size of the main airways is seldom larger than 20 square feet area, and the quantity of air travelling in each of the two splits does not often exceed 10,000 cubic feet per minute, or 20,000 cubic feet per minute total quantity of air passing through the entire mine.

The furnace is the universal rarefying power for ventilation. The steam jet as a principle has not been adopted, the only applications of steam for ventilating purposes being in working with underground engines, where the exhaust steam is discharged into the upcast shaft. The furnaces employed for ventilation are built a good deal after the Newcastle model; not so large certainly, but the same in shape. The firegrate of a ventilating furnace is about 7 feet long by 5 feet wide, placed about 20 inches or 2 feet above the floor. The spring of the arch is about 3 feet above the firebars, and the arch is turned with a rise of about 2½ feet in the centre. The furnace is usually placed

about 40 feet back from the upcast shaft, and the arch over the fire is built forwards into the shaft. The whole volume of the return air from the workings is made to pass over the firegrate, as the return current is never inflammable, and there is never any necessity for dumb drifts.

The usual form of winding engines employed is a pair of coupled horizontal engines, with cylinders varying from 20 inches to 30 inches diameter, 4 to 5 feet stroke, and 10 to 13 feet winding drums on the first motion. The weight of the hutch or wagon bringing the coal from the collier is about 4 cwts., and it contains about 10 cwts. of coal. Two hutches are usually raised at a time, so that the load on each rope is about 28 cwts., exclusive of the cage, which weighs from 5 to 7 cwts. The quantity raised from each pit ranges from 50 to 350 tons per day. Hemp ropes are in most common use: where wire ropes are used, round wire ropes are becoming more common in deep pits. Flat wire ropes were a good deal used; but there is an impression among Scotch engineers that they are not economical, and this is attributed to an unequal straining on the different plies forming the rope, and they have been abandoned in many collieries on this account.

The cost of sinking and fitting the pits of course depends entirely upon the depth and the quantity of water to be contended with. The nature of the strata in all parts of the coalfield is about the same, consisting of alternating beds of sandstone and shale. Taking the average quantity of water to be raised from a pit at 250 gallons per minute, which is considered a fair quantity in the district, the cost of fitting and sinking a pit is—

For a pit	120 yards	deep, about	£3,000.
,,	160 yards	,, ,,	£5,000.
,,	200 yards	,, ,,	£7,000.

These sums are exclusive of the cost of the working plant for properly working the colliery.

The cost of working the coal and putting it in wagons for delivery, including royalty and all charges, varies from 3*s*. to 4*s*. 6*d*. per ton of 22½ cwts. The first of these rates represents nearly the cost of raising the Wishaw Ell coal, and the latter the cost for the thinner seams under the Splint coal. The cost of raising and calcining the ironstone ready for delivery, including royalty and all charges, varies from 10*s*. to 18*s*. per ton of 22½ cwts. The general average cost of coal at the Coatbridge Iron Works, including lordship, cost of working, and railway charges, ranges from 5*s*. to 5*s*. 6*d*. per ton; and the cost of calcined ironstone from 13*s*. 6*d*. to 20*s*. per ton. Limestone is generally purchased from the limestone quarries, and costs, delivered at the works, about 5*s*. 3*d*. per ton.

The average royalty paid to the landlord is about 8*d*. per ton on coal. The Wishaw Ell coal, however, has recently realised as much as 1*s*. 3*d*. per ton. The lordship on gas coal is one-eighth of the hill price or the price at the pit mouth. On blackband ironstone the lordship is 2*s*. 6*d*. to 3*s*. 6*d*. per calcined ton of 22½ cwts.; and on clayband ironstone 1*s*. to 1*s*. 3*d*. per calcined ton of 22½ cwts. The lordship on limestone is about 4*d*. per ton.

Railway and Canal Accommodation.—The district is accommodated by the Caledonian, Edinburgh and Glasgow, Monkland, Scottish Central, and Glasgow and South Western Railways; and by the Monkland, Forth and Clyde, and Union Canals.

The Caledonian Railway lies over the most valuable part of the coalfield, and accommodates the most valuable coals in the upper series of minerals. On the line from Glasgow to Edinburgh it passes the Caulm limestone and fireclay field at Garnkirk. It enters upon the coalfield at Gartcosh station, running over the outcrop of the Kiltongue coal. It then passes the collieries of Gartsherrie, Coatbridge, Whifflet, Holytown, and enters upon the great Wishaw coalfield at Motherwell, and leaves it near Carluke. The Lesmahagow branch brings the gas coal from Lesmahagow, the ironstone from Bankend, and the upper coals from Larkall, Allanton, Ferniegair, and other collieries, as far up the line as to near Auchenheath. The Wilsontown branch takes the gas coal and ironstone from Wilsontown and Forth. The Clydesdale Junction branch accommodates the Newton and Rutherglen coalfields, and serves as a route for the conveyance of coal from the Wishaw field to the south and east districts of Glasgow. The coal traffic on this line finds a shipping port at Glasgow, Greenock, Granton, and Leith, on one system of railways; and at Kirkintilloch on board canal boats, by means of the Kirkintilloch branch of the Monkland Railways.

The Edinburgh and Glasgow Railway main line passes over the Possil and Bishopbriggs ironstone field, and with the assistance of the Scottish Central and Monkland Railways opens up a communication between the Coatbridge ironworks and the Denny ironstone field. The Redding collieries are on the main line, and the Blackbraes collieries are connected with it by the Blackbraes branch. The Milngavie and Helensburgh branches pass over the Milngavie and Kelvinside mineral field. The only shipping port of the Edinburgh and Glasgow line on its own system is Grangemouth, but it is in communication with Leith and Granton by the Caledonian Railway.

The Monkland Railway system accommodates nearly the whole area containing the accessible portion of the slaty bands of ironstone, and conveys all the ironstones arising on it to the ironworks over one system of railway. It accommodates the Bathgate coal and ironstone field, and the coalfields of Slamannan and Airdrie. The shipping ports on the canal are Causeway End and Kirkintilloch, and Boness on the sea board.

The ironstone fields of Govan, Paisley, and Johnstone, are accommodated by the main line of the Glasgow and South Western Railway.

The Monkland Canal conveys the coals in the Baillieston and Drumpeller districts to the ironworks or to Glasgow, or to Greenock by the Forth and Clyde Canal. The Union Canal conveys the coals from Redding and Causeway End to Edinburgh.

In conclusion, it may be stated generally that the area containing the most valuable coals, which are those above, and including the Splint coal seam, is bounded on the west by Glasgow; on the north by Greenfield, Cardowan, Easterhouse, Heatheryknowe, Gartsherrie, Airdrie, and Standrig; on the east by Clarkston, Chapelhall, and Cleland; and on the south by Dalserf and Larkhall. The area containing the

Virtue Well, Kiltongue, and Drumgray coals, and the ironstones in their locality, extends as far north as Jawcraig, Falkirk, and Grangemouth; east as far as Bathgate; and south to near Carluke. The area containing the seams in the locality of the Possil, Garscadden, and Dalry ironstones, extends as far north as Duntocher, Milngavie, Kilsyth, and Denny; and as far east as Bathgate and Wilsontown; and nearly as far south as Lanark. It has been from these districts that the supply of coal and ironstone has been almost wholly derived during the last hundred years.

The whole Glasgow mineral district, forming the subject of the present paper, contains 111 blast furnaces, producing about 900,000 tons of pig iron per annum, and consuming about

2,500,000 tons of coal.
1,485,000 tons of ironstone.
445,000 tons of limestone.

The entire district contains about 260 collieries, which raise annually about 8,500,000 tons of coal, or nearly 77 per cent. of the whole produce of Scotland.

LORD STANLEY ON THE PATENT LAWS.

There is a feeling in the minds of some thinking men, whom we should be sorry to accuse of vanity, that every subject they encounter, which appeals to the reasoning faculty, they must of necessity be able to compass, and that without the application of persistent investigation. When, however, they meet, as they are likely to do, with a check, and find themselves at fault in their conclusions, they will then take a short cut to the solution of their difficulties. If it is a question of faith that has puzzled them, they will cast anchor in the fathomless abyss of scepticism; or if it relates to some branch of science, they will ignore the facts on which that science is founded, because they appear to run counter to other and perhaps easily reconciled facts. This apparent desire to arrive at some decision is not due to a natural impetuosity of temperament, for we have recognised it alike in the sound lawyer and the calm politician. Men of this stamp would seem to say, "Anything is better than doubt," and then to make their plunge at a decision. In this way we can account for the adverse verdicts which have been from time to time pronounced against the Patent Laws by men who, had they but sufficient facts before them, were eminently qualified to judge of their action on the individuals and communities they are designed to affect. The lull in politics during the last month has given Lord Stanley an opportunity of expressing his opinion on the Patent Laws more fully than when he last broached the subject in Parliament, and his speech before the Liverpool Chamber of Commerce has produced some spirited replies. Our facetious contemporary, *Punch*, has not lost the opportunity thus afforded him of announcing his views on this branch of political economy, and, in a satirical letter to Lord Stanley, headed "Hang the Inventor," he has

expressed himself as a believer in the popular "delusion" which we, in common with all inventors, share on the subject. At the same time, an article appeared in the *London Review*, on the policy of granting patents, remarkable for its calm argumentative tone, and pointing out wherein Lord Stanley has allowed himself to be led away. We willingly give this paper further publicity, in the hope that it may confirm the faith of some whose views have of late been greatly shaken by the course of persecution (for we can find no better word) which some patentees have recently thought proper to take in establishing their alleged rights, to the great detriment of the patent interest generally. The following is the paper referred to:—

"Lord Stanley has, at the Liverpool Chamber of Commerce, announced his adhesion to the views of those who would abolish patents for inventions. The conversion of so eminent a statesman to that way of thinking will be viewed as a great triumph by the very small, but very dogmatic, class of writers to whom he gives the support of his name; and, as he was chairman of the committee which lately reported on the amendment of the law on that subject, it must be fairly admitted that he has not decided without full means of understanding the subject. But his opinions are not quite unqualified, and his qualifications derive peculiar importance from the character of his mind. He does not dispute that the system of rewarding a meritorious invention by securing the sole use to the inventor for a limited term of years is in principle sound, just, and reasonable. He candidly quotes the doctrine of Mr. John Stuart Mill, that the abolition of the Patent Laws would be 'not free trade, but free right of stealing;' and he admits that the system is not only supported by very great thinkers, but by the laws of every civilized community in Europe and in America. But he rests his whole opposition on the difficulty of fairly carrying out the principle in detail, and on the evils of which the present state of the law is productive. Now, this is very characteristic of Lord Stanley's peculiar turn of mind. He is eminently practical, eminently incapable of imagination or creation. No man sees more clearly existing abuses, blunders, evils; but he cannot conceive the working of a system which he does not see. So, looking at the mischiefs which a bad patent law operates, he rushes to the conclusion that there is no remedy for them but the abolition of the Patent Laws altogether; because he is incapable of foreseeing the larger mischiefs which would be a consequence of that abolition, and equally incapable of seeing the construction of a system which would avoid the dangers of abolition while mitigating the evils of the existing rules.

"This striking mental characteristic becomes apparent on a mere glance at the objections which Lord Stanley takes to the system of a patent law. Admitting, as we have observed he does, the soundness of the principle in theory, his objections are wholly of detail. In the first place, he says we have an enormous multiplication of patents, many for very trivial improvements; some taken out on mere speculation that they must be bought up by those who would make a real improvement; others created or bought up by large manufacturers, in order to prevent rivals from entering the trade. Then, in the second place, he observes that many minds may, at the same moment, be in pursuit of, and on the

verge of discovering, some useful idea, and that it is unreasonable to allow the accident of a patent for it being first secured by one of the number to bar the way to all the rest. In the third place, he objects to the immense expense of legal inquiries into patents—an expense, he thinks, not dependent on the defects of existing tribunals, but on the nature of the questions to be investigated; and he denies that any of these evils could be obviated or diminished by the establishment of any controlling power over the granting of patents, with the design of limiting them to strictly novel and useful inventions, because he thinks no tribunal could perform such a task, or bear up against the remonstrances of those whom it rejected.

"But while the inconveniences of the existing system are thus vividly portrayed, it is certainly remarkable to find so entire an absence of appreciation of the inconveniences of its total abolition. Let us try to supply this important void in the argument. Supposing there was no protection of inventions, what would be the first consequence? In the case of an inventor engaged himself in the manufacture in which he had devised a new procéss, the first impulse would be that he should endeavour to preserve his secret. But a manufacture conducted in secrecy is at enormous disadvantage. The restrictions of the Excise Laws, from which so many of the branches of our native industry are now only emerging, and which for so many years crippled their growth, are nothing to those of attempted secrecy. Processes must be separated, that the workmen may not comprehend the mystery, immense wages must be paid to retain them from deserting to competitors, simplicity must be avoided, and expense introduced for no purpose but to complicate and confuse the methods used. Experiments for further improvement must be avoided, for they would not only tend to disclosure, but to the loss of the outlay incurred in establishing the existing expensive methods. After all, if the attempt to maintain the secret was successful, the public would be no gainers, for it would constitute a strict monopoly, and, unlike a patent, a monopoly that would be lasting till either the secret was discovered, or till it died with its first employers. If, however, a rival succeeded in learning it, the monopoly would still be as strict and injurious; and only in the case of the secret becoming universally known before the expiry of the fourteen years during which a patent would have protected it, would there be the smallest possibility of public gain. But if we take the case of an invention not applying to a process used by the manufacturer, but of an improvement in the means by which work is done—in machinery, for example, to be employed in a given trade—we shall find a different class of evils resulting from the abolition of protection to novelty. Here there can be no secrecy, for the finished article shows the improvement on its face. But what motive will there be to induce a maker of machinery on a large scale to improve its character, when by so doing he will not raise any fresh distinction in his own favour as compared with his competitors, seeing that all of them may the next day imitate, without the expense of any previous trials, the improvement which he has elaborated at great cost of time and money? Nothing obviously can so tend to make every manufacturer set his face against improvements, as the knowledge that he will have all his pains for nothing, and be after all undersold in the very article he has striven to perfect.

Lastly, let us view the case of inventions not made by manufacturers, or by those in their employment, but by men wholly outside the trade. A very large proportion of our most valuable inventions belong to this category. Now, it is certain that the main motive of all such minds is the hope of being able to secure a reward. Other motives, of course, exist beside this. There is the hope of glory, and the innate impulse of invention. But few indeed would exercise the immense perseverance and labour needful to make any such valuable idea practically available, unless stimulated by the expectation of the reward of wealth, as well as of barren honour. Now, from this class of persons the total abolition of patents would take away every hope of such a result. They can turn their idea to profit only by selling it to some person to whom it would be practically valuable; but who will buy when, by the mere fact of the purchase and use, the idea becomes the property of all the world? Thus, from whatever point we view the system which Lord Stanley would establish, we shall find that his 'free stealing' would be a disastrous policy for the nation. He objects that the multiplicity of patents makes progress slow; but his remedy would stop progress altogether. He complains of manufacturers being hampered; but he would hamper them infinitely more by compelling them to advance, if at all, under the fetter of attempted secrecy. He urges that several inventors may be disappointed by one obtaining a prior patent; but he would disappoint and deter every application and research by refusing recompense to all alike. This rough doctoring of abuses is not statesmanship, and will not, we are persuaded, gain the support of the English public, much as it is inclined to admire and respect Lord Stanley's zeal and abilities.

"We do not, as our readers know, at all defend the abuses of the present law. But neither do we believe them irremediable. And it ought always to be kept in view that the Patent Law system is not based solely upon a recognition of the right of a man to profit in the results of his own ideas, but upon the principle of a bargain between him and the State. The public says, 'You shall be protected, for a moderate term of years, against infringement, provided you describe your invention so distinctly that after that period any person can use it.' This is the fundamental condition of the validity of every patent. Of course it would be possible for the State to buy up, at a money price, the idea which it thus purchases, for the public benefit, by grant of a limited monopoly of use; and this is the course often hinted at by those who, advocating the abolition of patents, cannot resist the argument of unfairness to the owners of ideas. But it would be immediately found that to assess the value in advance would be wholly impracticable, that it would give equal dissatisfaction to the public and to inventors, and that it would lead often to the result of large sums being given for that which is useless, and small sums for that which is of infinite value. Therefore, the State wisely leaves the reward to be assessed by the value of the invention; and what is wanted to relieve our system from its present evils is merely the development of this principle. If a patent were not allowed to stand unless in three or five years the patentee could prove public appreciation by evidence of its use (or of combination to resist its use), the evil of multiplicity of patents, and of their check to further invention,

would be almost wholly swept away, for in no case could they operate a longer delay unless they were intrinsically valuable. And if we had a tribunal which, in return for the patent fees, would pass no application which was not at least novel, and which would be competent to judge with accuracy whether it was afterwards infringed, we should enormously reduce the number, and not less the expense, of patent cases. Lord Stanley disputes this. But he must be alike unconversant with law and with science, if he does not know that a case is prolonged in precise proportion to the incompetence of the Court which tries it, and if he thinks it impossible for a properly-qualified Court to refuse its preliminary sanction to an invention in substance already known. It is not necessary to argue seriously that a jury picked up from the streets cannot expeditiously and accurately decide a point which a scientific judge would dispose of in half an hour, and that such a judge would refuse sanction to many a patent which the Attorney and Solicitor-General now allow to pass with the confirmation that it is novel and useful."

Provisional Protection Granted.

1865.

[*Cases in which a Full Specification has been deposited.*]

1837. Thomas Cato McKeen, of Irvington, New Jersey, U.S.A., a diving apparatus for submarine purposes.

1838. Thomas Cato McKeen, of Irvington, New Jersey, U.S.A., impd. mode of elevating ships or boats in the water, to enable them to pass over sand bars, shallows, and the like, and for raising sunken vessels, &c.

The above bear date July 12th.

1844. George Clayton Collyer, of St. George-street, East, and Charles Lewis Roberts, of St. John-street, Clerkenwell, utilizing the stalks, smalls, and waste of tobacco for certain purposes.—*July 13th.*

1846. Henri Adrien Bonneville, of Paris, impts. in copying letters, plans, and other manuscripts, and in the apparatus and substances employed therein,—a communication.—*July 14th.*

1893. Richard Clark Bristol, of Chicago, Illinois, U.S.A., impts. in slide valves. —*July 20th.*

1971. Thomas Drew Stetson, of New York, impts. in the construction of hats,—a communication.—*July 31st.*

2098. William Bünger, of Southampton-buildings, apparatus or means for ascertaining the quality and condition of grain and seed,—a communication.—*August 14th.*

Cases in which a Provisional Specification has been deposited.

964. John Bethell, of King William-street, impts. in building barges, ships, and other vessels.—*April 5th.*

1002. William Edward Gedge, of Wellington-street, impd. application of steam power to locomotion on ordinary roads, — a communication. — *April 8th.*

1036. Robert Turner, of Deptford, impd. chain or iron-cable shackle.—*April 11th.*

1037. Gustave Wilhelm Rothleb, of

Soho, apparatus or mechanism for flying through the air.—*April 12th.*

1113. Edward Wilson, of Pall-mall, impd. lamp or signal for calling cabs or other vehicles by day and night.—*April 21st.*

1188. Edward Moore, of Tewkesbury, impts. in the manufacture of dress shirts and dresses made by means of the stocking frame.—*April 28th.*

1225. Thomas Hay Campbell, of Madras, improving and strengthening shields of steel, iron, or other material for ships, fortifications, and other constructions.—*May 2nd.*

1243. Gustave Josse, of Giltspur-street, impts. in paper hangings.—*May 4th.*

1288. Charles Stuart Baker, of Fleet-street, impts. in paddle-wheels,—a communication.—*May 9th.*

1374. Joseph Mitchell and George Tilfourd, of Sheffield, impd. method of testing railway and other springs.—*May 18th.*

1391. Charles Bradley, of Oldham, impts. in machinery for spinning and doubling cotton and other fibrous substances, — a communication.

1398. Joseph Armstrong, of Masbrow, Yorkshire, impts. in the manufacture of crossings for the permanent way of railways, and also in tyres for wheels.

The above bear date May 20th.

1440. Henry Edward Newton, of Chancery-lane, impts. applicable to spinning, weaving, and knitting machines,—a communication.—*May 25th.*

1492. Richard Howarth, of Gloucester-crescent, Paddington, impts. in apparatus for increasing the safety of railway passengers and trains, signalling, lighting, and forming a communication between all parts of such trains; also for securing the carriage doors.—*May 31st.*

1524. Thomas Forster and James Eckersley, of Bolton, Lancashire, impts. in looms for weaving.—*June 3rd.*

1537. James Atkins Woodbury, of Boston, U.S.A., impts. in paper or cloth-lined paper collars, and in the machinery for manufacturing the same.—*June 5th.*

1585. Edward Thomas Hughes, of Chancery-lane, impts. in the means of producing from rosaniline blue and violet colouring matters, soluble in water,—a communication.

1588. Gaetan Bonelli, of Paris, impd. method of obtaining or producing optical illusions.

1593. William James Hixon, of Bayswater, impts. in the permanent way of railways, and in locomotives applicable thereto.

The above bear date June 12th.

1619. Thomas Rothwell, of Ramsbottom, Lancashire, impts. in rubbing or rolling woollen or cotton cardings, and in apparatus connected therewith.

1622. Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, impts. in generating steam.

1623. George Edgar Way, of Norfolk-street, Strand, impts. in the manufacture of pianofortes,—a communication.

The above bear date June 15th.

1640. Edwin Byerley, of Bristol, impts. in the means of communication between passengers and guards of railway trains.

1641. George Haseltine, of Southampton-buildings, impd. sewing machinery and stitch formed by the same,—a communication.

1642. Valentine Baker, of Dublin, impts. in hydraulic motive-power machinery.

The above bear date June 17th.

1653. Prospero Carlevaris, of Genoa, producing a light applicable to photographic purposes, to lighthouses, and to other illuminations.

1654. Isham Baggs, of Chancery-lane, impts. in electric telegraph instruments and relays.

1656. William Clark, of Chancery-lane, impts. in the means and apparatus for generating motive power,—a communication.

1657. James Parrish, Charles Thatcher, and Thomas Glasscock, of Goswell-street, preventing the forcing or wedging open iron safes, iron doors, and strong rooms.

1658. John Scholl, of Berwick-street, Soho, impts. in gas burners.
1659. William Henson, of Nottingham, impts. in apparatus applied to railway carriages, to enable the passengers in a train to communicate with the guard and engine-driver thereof.
1660. Mark Audinwood the younger, of Weston-upon-Trent, impts. in reaping and mowing machines.
1661. Duncan McGlashan, junior, of Glasgow, impts. in sewing machines, and in the machinery or apparatus connected therewith.
1662. Evariste Vignier, of Great Tower-street, impts. in distilling and rectifying, and in the apparatus employed therein; parts of which improvements are applicable to steam generators.
1663. Emile Dupont, of Fayt Iron Works, Belgium, impd. system of wheels for railway carriages.

The above bear date June 20th.

1665. William Clark, of Chancery-lane, impts. in apparatus for typographic and lithographic printing,—a communication.
1667. Michael Henry, of Fleet-street, impts. in apparatus for measuring fluids,—a communication.
1668. Charles Henry Gardner, of West Harding-street, Fetter-lane, impts. in apparatus for polishing, smoothing, or facing, especially applicable to lithographic stones.
1669. Charles Talbot Porter, of New York, U.S.A., impts. in surface condensers for steam engines, and in feeding boilers therefrom.
1670. William Charles Rickman, of Lithanger, Southampton, impts. in the rigging of sailing-boats and vessels.
1671. William Roberts, of Ranelagh-road, Pimlico, impts. in machinery for cutting dovetails for joiners' work.

The above bear date June 21st.

1672. Samuel Godfrey, of Middlesborough-on-Tees, impts. applicable to furnace bars and fire grates.
1673. Nicholas de Becker, of Gloucester-road, Old Brompton, impts. in umbrellas and parasols.
1674. Edward Kenworthy Dutton, of Sale, Cheshire, impts. in apparatus for measuring and indicating the flow of liquids.
1675. Julian Moses Abrams, of Moorgate-street, impts. in apparatus for the reception of coin.
1676. Michel Siégrist, of Montpelier-road, Brompton, impts. in apparatus for the use of passengers and others for signalling on railway trains.
1677. William Edward Newton, of Chancery-lane, impts. in surface condensers,—a communication.
1679. James Gale, of Plymouth, impts. in preparing and treating gunpowder.

The above bear date June 22nd.

1680. Archibald Edward Dobbs, of Lincoln's-inn, impts. in drags for carriages.
1681. Candido Ravelli, of Bedford-square, impts. in turntables.
1682. Michael Dietrich Rosenthal and Solomon Gradenwitz, of Church-row, Houndsditch, impd. compositions in imitation of ivory and woods, to be employed in the manufacture of umbrella-tips, umbrella and walking-stick handles, and other useful and ornamental purposes.
1683. Lesley White, of Paisley, N.B., impts. in clay tobacco pipes.
1684. William Jeremiah Murphy, of Cork, impd. apparatus for stopping railway trains.
1685. William Lusty, of Birmingham, impts. in machinery for the manufacture of needles.
1686. Edward Finch, of Chepstow, impts. in machinery and apparatus for the manufacture of rivets, bolts, spikes, and similar articles.
1687. Henry Saxon Snell, of Chancery-lane, and Frederick Edward Thomas, of Manchester-terrace, Liverpool-road, impts. in apparatus used in supplying gas to burners.

The above bear date June 23rd.

1688. Henri Adrien Bonneville, of Paris, impts. in life boats,—a communication.
1689. Robert Eastman, of Islington, impts. in castors.
1690. Matthew Andrew Muir and James Mc Ilwham, of Glasgow, impd.

sanitary apparatus or arrangements for preventing noxious exhalations, such as arise when coating or treating iron or other articles.

1691. Richard Archibald Brooman, of Fleet-street, impd. portable table or seat,—a communication.

1692. George Turton, of Sheffield, impts. in floating docks.

1694. Frederick Germain David, of Paris, impd. composition for the manufacture of printers' rollers.

1695. Joseph Solomon, of Red Lion-square, impts. in the preparation of magnesium for illuminating purposes, —a communication.

1696. Charles Ross Bamber, of Jersey, impd. apparatus for producing the magnesium light.

1697. William Clark, of Chancery-lane, impts. in the means and apparatus for consuming smoke,—a communication.

The above bear date June 24th.

1698. Thomas Lewis Jowett, of Swansea, impts. in bricks.

1699. John Nugent, of Birkenhead, impts. in means or apparatus for communicating signals on railway trains in motion.

1700. Morris Ashby, of Staines, impd. brewers' and distillers' refrigerator, or apparatus for cooling liquids, condensing steam or other vapours.

1701. Josse Egide Spanoghe, of Antwerp, impd. hydraulic apparatus for producing motive power.

1702. Richard Archibald Brooman, of Fleet-street, impts. in machinery for printing in colors,—a communication.

1703. Charles Worssam, of Commercial Wharf, Kingsland-road, and George Evans, of Gloucester-place, Portman-square, impd. pulping and compressing machine for the treatment of peat as a fuel and gas for illuminating purposes.

1704. Samuel Stephen Bateson, of Bolton-street, Mayfair, impts. in croquet mallets.

1705. John Whittle, of Boston, Lincolnshire, impts. in forming the permanent ways of railways.

1706. John Medhurst, of Rotherhithe-street, impts. in portable punching apparatus.

1707. William Edward Newton, of Chancery-lane, impts. in the manufacture of hats and other felted goods and fabrics,—a communication.

1708. William Edward Newton, of Chancery-lane, impt. in pianofortes, —a communication.

The above bear date June 26th.

1709. Henry Martyn Kennard, of Crumlin, near Newport, impts. in machinery for rivetting and for making rivets.

1711. Richard Archibald Brooman, of Fleet-street, impd. method of, and apparatus for, burning liquid hydrocarbons, and the employment thereof for heating purposes,—a communication.

1712. James Spratt, of Stranraer-place, Maida-vale, impts. in apparatus for cutting hay, straw, and other vegetable material.

1713. John Kirkham, of Manchester, impts. in securing the rails of railways.

1714. John Henry Johnson, of Lincoln's-inn-fields, impts. in cotton gins,—a communication.

1715. William Brooks, of Bristol, impts. in heating chisels, knives, plane irons, gouges, augers, steels, shears, scythes, and saws.

The above bear date June 27th.

1716. Henry George Fairburn, of St. Luke's, impd. mode of combining and forming small coal or coal dust into lumps, blocks, or otherwise, to be employed for the purposes of fuel.

1717. William Ingham, of Manchester, impts. in circular pressing machines for finishing woven fabrics.

1718. John Kay Farnworth, of Alderley Edge, Cheshire, impts. in, or applicable to, railway and other carriage windows.

1719. William Edward Newton, of Chancery-lane, impts. in the preparation of amalgams of quicksilver or mercury, and in the application of such amalgams to various purposes in the arts,—a communication.

1721. James Webster, of Glasgow, impts. in under vests.

1722. William Percival, of Ashton-by-Budworth, impd. table or support to

be employed in the dressing and finishing of cheeses.

1723. Richard Boot and John Coxon, of Nottingham, impts. in twist-lace machines.

1724.—Paul Jacovenco, of Bucharest, impts. in apparatus for the decantation and raising of petroleum and other oils.

1725. William Edward Newton, of Chancery-lane, an impd. shirt front,—a communication.

1726. Edwin Reynolds, of Nunhead, impts. in apparatus for preventing the opening of sash windows from the outside, and for the secure fastening thereof.

1727. William Botham, of Sheffield, impd. food or fluid regulator for feeding bottle and other tubes.

The above bear date June 28th.

1728. Robert Henry Leese, of New York, U.S A., impts. in machinery or apparatus for cutting, punching, and bending sheet metal,—a communication.

1729. David Mercer, Thomas Mercer, Jonathan Mercer, and Joseph Mercer, of Great Harwood, near Accrington, impts. in sizing machines for sizing yarns, beams, or warps to be woven.

1730. Richard Archibald Brooman, of Fleet-street, impts. in printing threads employed in weaving,—a communication.

1731. John Cox, of Gorgie Mills, Edinburgh, impts. in oars, paddles, rowlocks, seats, and fittings, for boats and vessels.

1732. George Lizars, of Paris, impts. in dry gas meters.

1733. Alexander Prince, of Trafalgar-square, impd. self-acting apparatus for distributing the feeding materials in high furnaces,—a communication.

1734. William Edward Newton, of Chancery-lane, impts. in preventing the incrustation of steam boilers,—a communication.

1735. William Edward Newton, of Chancery-lane, impts. in locks,—a communication.

The above bear date June 29th.

1737. William Schofield, of Heywood, Lancashire, impts. in the manufacture of gas retorts and other articles made of fire-clay, and in furnaces for burning the same, and for other purposes.

1738. Henry Powell Tipper, of Willenhall, Staffordshire, impts. in manufacturing gun barrels and tubes of cast steel and homogeneous iron.

1739. François Delamere - Deboutteville, of Fontaine le Bourg, France, impts. in and applicable to machinery for doubling and drawing cotton and other fibrous substances.

1741. Richard Archibald Brooman, of Fleet-street, impts. in the manufacture of collars and cuffs,—a communication.

1742. Richard Archibald Brooman, of Fleet-street, impts. in apparatus for tuning pianos,—a communication.

1743. John Keighley, of Bradford, impts. in looms for weaving.

1744. William Hook Davey, of Blundell-street, Caledonian-road, impts. in washing machines.

1745. Edwin Elliott, of Wharf-road, City-road, impts. in steam boilers, furnaces, and engines, and in parts connected therewith.

1746. Louis Faure, of Paris, impts. in railway carriages; which impts. are intended to neutralize the destructive effects arising from the collision of trains.

The above bear date June 30th.

1747. George Davies, of Serle-street, Lincoln's-inn, impts. in knitting machines,—a communication.

1748. William Robert Lake, of Southampton-buildings, impd. mode of pressing and moulding clay, sand, or cement for making bricks and for other purposes,—a communication.

1749. James Atkins, of Birmingham, impts. in the manufacture of certain kinds of metallic tubes and rods, and in ornamenting metallic tubes and rods.

1750. William Edward Newton, of Chancery-lane, impts. in breech-loading fire-arms, and in cartridges to be used therewith,—a communication.

1751. William Mc Gregor, of Kidbrooke-villas, Blackheath, impts. in the points and crossings of railways.

1752. John Calvert, of the Strand,

impts. in apparatus for propelling ships and other vessels.

The above bear date July 1st.

1753. Isham Baggs, of Chancery-lane, impts. in submarine telegraphy, which improvements are also applicable in some cases to land telegraphy.

1754. Charles de Bergue, of the Strand, impts. in locomotive engines,—a communication.

1755. Edward Deane, of the City, impts. in tubular structures, rendering them specially applicable for ships' masts and building purposes.

1756. John Franklin Jones, of Rochester, New York, U.S.A., impts. in machines for making paper board.

1757. Stephen Bates, of New Radford, Nottingham, impts. in the manufacture or production of bobbin net or twist lace made on bobbin net or twist lace machines.

1758. George Hurn and Daniel Hurn, of Norwich, impts. in the manufacture of mats, matting, and brushes.

1759. Joseph Naveaux, of Strepy-Bracquegnies, Belgium, impts. in apparatus for stopping and retarding railway carriages and locomotive engines.

1760. Martin Benson, of Hinde-street, Manchester-square, impts. in steam-pumping machines or engines.

1761. Louis Henry Gustavus Ehrhardt, of Aldridge-road-villas, Bayswater, impts. in vices.

The above bear date July 3rd.

1762. Stephen Wright, of Smethwick, impts. in axles for carriages.

1763. Philip Passavant, of Bradford, impd. linings for ladies' dresses,—a communication.

1764. William Clapperton, of Johnstone, Renfrew, and Abram Lyle, of Greenock, impts. in apparatus for setting up casks or barrels.

1765. Sylvain Benjamin Labouret, of Paris, impts. in the construction of suspended bridges, roads, aqueducts, or other ways.

1767. Josiah Harrington, of Lansdowne-terrace, Acre-lane, Brixton, impts. in carriages.

1768. William Jenkins, of Abergavenny, impts. in the manufacture of lamp oils.

1769. James Edwards Wilson, of Grasmere, Torquay, impts. in locomotive engines, and in springs of railway carriages.

1770. Richard Archibald Brooman, of Fleet-street, impd. method of dissolving pitch,—a communication.

The above bear date July 4th.

1771. William Edward Gedge, of Wellington-street, impd. circular endless railway,—a communication.

1772. Frederic Newton Gisborne, of West Strand, impts. in apparatus for giving signals on board ships; and which are also applicable for other purposes.

1773. John Braithwaite, of Crook, near Kendal, impts. in machinery or apparatus for turning and cutting wood and other substances, to be employed in the manufacture of spools or bobbins, or other similar articles.

1776. John Jobson, of Derby, and John Farmerley Dickson, of Leicester, impts. in the conversion of wrought or malleable iron into steel, and in the means or apparatus employed therein.

1777. Joseph Wace Gray, of St. Dunstan's-hill, City, impts. in machinery for cleaning and decorticating rice and other grains and seeds.

1778. George Low, of Dublin, impd. machinery for boring rocks and hard substances.

1779. Harry Emanuel, of New Bond-street, manufacture or improvement in ornaments for personal wear.

The above bear date July 5th.

1780. Hermann Beigel, of Finsbury-square, impts. in the means of obtaining or producing oxygen, applicable to various useful purposes.

1781. Thomas Symes Prideaux, of Piccadilly, improving draught beer, ale, porter, and cyder.

1782. George Carter, of Willenhall, Staffordshire, impts. in locks and latches, and in staples and spindles for the same.

1783. James Henry Smith, of Oxford-street, impts. in harmoniums, organs, and other musical instruments; a part of which invention is applicable to turning over the leaves of music.

1784. William Thomson, of Glasgow College, and Cromwell Fleetwood Varley, of Beckenham, Kent, impts. in electric telegraphs.

1785. Charles Frederick Claus, of Fernhead, near Warrington, impts. in obtaining sulphates and carbonates of potash and soda.

1786. John Henry Johnson, of Lincoln's-inn-fields, impts. in railway switches,—a communication.

1787. John Franklin Jones, of Rochester, New York, U.S.A., impts. in machinery for the manufacture of paper board and paper.

1788. William Edward Gedge, of Wellington-street, impd. automaton lay figure,—a communication.

1789. Alfred Vincent Newton, of Chancery-lane, impts. in the manufacture of boxes suitable, among other uses, for containing paste blacking and other cheap marketable articles,—a communication.

1790. Alfred Vincent Newton, of Chancery-lane, impts. in the manufacture of superphosphate of lime from guano,—a communication.

1791. Joseph Wilson Swan, of Gateshead, impts. in the production of printing surfaces by photographic agency, and in obtaining prints therefrom.

The above bear date July 6th.

1793. James Marius Macrum, of Hill-street, Knightsbridge, impts. in the manufacture of iron,— a communication.

1794. Pierre Mathurin Charles Béziel, of Paris, impts. in the manufacture of chains, bracelets, necklaces, and other articles of jewellery.

1795. Augustin François Morelle, of Paris, impd. portable pocket gas generator or gazogene.

1796. Eric Hugo Waldenström, of Manchester, impts. in machinery or apparatus to be employed in the manufacture of metallic bolts, rivets, and spikes.

1797. Isaac Peel and William Hargreaves, of Bradford, Yorkshire, impts. in manufacturing grease from soap suds.

1798. Thomas Sheldon, of Sedgley, Staffordshire, impts. in the manufacture of the handles of smoothing irons or sad irons; which said impts. may also be applied to the manufacture of the handles of various other articles.

1799. Henry Duncan Preston Cunningham, of Bury, Hants, impd. method of training guns.

1800. Thomas Frederick Henley, of Pimlico, impd. material for stuffing seats, cushions, mattresses, and other articles,—a communication.

1801. Fischer Alexander Wilson, of Abingdon-street, Westminster, impts. in carriages for breech-loading ordnance.

1802. John Hopkinson, of Regent-street, and John Whitelock, of Leeds, impts. in organs, harmoniums, and other similar keyed wind musical instruments.

1803. James Bullough, of Baxenden, near Accrington, impts. in looms for weaving.

1804. Joseph George, of King's Holme, Gloucestershire, impd. manufacture of coffins and air-tight receptacles.

1805. Robert Green, of Mortimer-street, and John William Heinke, of Great Portland-street, impts. in fire-arms.

1806. William Goulding, of Leicester, impts. in ornamental fences and baskets to contain flowers and other articles.

1807. George Fentiman, of Upper East Smithfield, impts. in the preparation of paints.

1808. James Willis, of Stocksbridge Works, near Sheffield, impts. in the construction of portable dark tents or chambers for photographers.

The above bear date July 7th.

1809. Isham Baggs, of Chancery-lane, impts. in the production of artificial light, and in the apparatus connected therewith.

1810. William Edward Newton, of Chancery-lane, impd. break for retarding the progress of wheel carriages,—a communication.

1811. George Baldwin Woodruff, of Cheapside, impd. apparatus for gauging and marking the width of tucks and pleats on fabrics under operation in sewing machines.

1812. John Fry Heather, of Marlboro'-road, Old Kent-road, impts. in the construction of locks and keys.

1813. Richard Archibald Brooman, of Fleet-street, impts. in the manufacture of cast steel,—a communication.

1814. Benoni Collins and John Butterfield, both of Manchester, impts. in machinery for cutting fustian and like fabrics.

1815. Joseph Byford, of Long Melford, Suffolk, impts. in reaping and mowing machines.

1816. Hector Auguste Dufrené, of Paris, impd. self-acting apparatus for obtaining a circulation of volatile liquids,—a communication.

1817. Christopher Oswald Papengouth, of Russell-square, impts. in constructing ships and vessels.

The above bear date July 8th.

1818. George Thomas Livesey, of Old Kent-road, impts. in treating ammoniacal liquors for purifying gas and other purposes.

1819. Henry Schooling, of Bethnal-green, pearled or ornamented confectionery.

1820. William Alexander Lyttle, of the Secretary's Department, General Post Office, impts. in the means and and apparatus for increasing the mechanical power of steam.

1821. Richard Archibald Brooman, of Fleet-street, impts. in steam carriages and in adapting wheels for common roads to railways,—a communication.

1822. David Cowan, of Mansfield-road, Kentish-town, impts. in lifts for transferring passengers, goods, and heavy weights from the lower to the upper floors of hotels, club houses, and other buildings, with greater safety than heretofore.

1823. Frederick Taylor, of Carey-street, Chancery-lane, impts. in fountains.

1824. William Scott Underhill, of Newport, Arthur Hopkins Corden, and John Corden, of Chatwell, Staffordshire, impts. in reaping machines.

1825. John Jones, of Liverpool, impts. the manufacture or "making-up" of trousers.

1826. Robert Hineson, of Liverpool, impts. in food for horses, and in the preparation of the same.

1827. Henry Fearnley, of Halifax, and Christopher Smith, of Batley, impts. in machinery for washing, wringing, mangling, and drying domestic clothes or other fabrics and fibrous substances.

1828. George Firmin, of Henley, Suffolk, impts. in treating and preparing flax for scutching.

The above bear date July 10th.

1829. James Soutter, sen., and Thomas Christie, of Edinburgh, impd. means for marking progress in the game of croquet and other games.

1830. Frederick Massey, of Tysoe-street, Clerkenwell, impts. in ships' logs.

1831. Hector Auguste Dufrené, of Paris, impts. in the treatment of copper and nickel ores,—a communication.

1833. Hector Auguste Dufrené, of Paris, impd. process for obtaining oxygen,—a communication.

1835. Benjamin Fothergill, of Cornhill, impts. in regulating or controlling the power employed in actuating sewing and other machines of a light nature.

1836. Morris Horsey Keene, of Croydon, impts. in traction engines,—a communication.

The above bear date July 11th.

1839. Samuel Burt Howlett, of Chelsea, instrument or anemograph for delineating and registering the direction and force of the winds.

1840. Auguste Denayrouze, of Espalion, Aveyron, France, impts. in apparatus and equipments used by persons employed under water; part of the improvements being also applicable for the use of persons employed where noxious gases or vapours prevail.

1841. Harrison Blair, of Kearsley, Lancashire, impts. in the production of gases from aqueous vapour, and in the application thereof to heating purposes.

1842. James Edwards Wilson, of Grasmere, Torquay, impts. in the permanent ways of railways.

1843. John Saunders and Joseph Piper, of Kidderminster, impts. in apparatus employed in the manufacture of tin and terne plates.

The above bear date July 12th.

1845. Alexander Mackie and James Proctor Jones, of Warrington, impts. in apparatus for "setting up" or composing type for printing.—*July 13th.*

1847. William Meddowcroft, of Hammersmith, impts. in the construction of rollers for window blinds, and in apparatus connected therewith.

1848. John Bishop Chatterley, of Birmingham, impts. in the manufacture of cruet frames.

1849. John Clayton, of West Bromwich, impts. in ingot moulds, and in casting metals.

1850. David Fulton and John Fulton, of Glasgow, impts. in mandrils for rollers, suchas are used for printing or embossing.

1851. John Morrough Murphy and James Morrough Murphy, of Cork, impts. in staining and graining woods.

1852. William Podmore Bayliss, of Lambeth, impts. in apparatus for the locomotion of trains on railways by atmospheric pressure.

1853. Stevens Tripp, of Danes-inn, Strand, impts. in the means of securing envelopes for enclosing letters and other papers.

1854. George Clark, of Napier-street, Dover-road, impd. drawing instrument,—a communication.

1855. Andrew Edward Molin, of Fahlun, Sweden, impts. in separating gold from ores containing copper and gold.

1856. Augustus de Mentz, of Somerford-grove, Stoke Newington, and Thomas Wickens Fry, of Downs-road, Clapton, impts. in railway signals.

The above bear date July 14th.

1857. Richard Vine Tuson, of St. Paul's-road, Camden-town, impts. in the preparation and preservation of foods for animals.

1858. Samuel Hingley, of Dudley, making skelps for iron or steel tubes direct from the rolls, and for machinery to be used in the same.

1859. William Hughes, of Manchester, impts. in presses,—a communication.

1860. John Crawford Walker, of La Porte, Indiana, U.S.A., impts. in the construction of springs for railroad and other carriages.

1861. William Robert Lake, of Southampton-buildings, impts. in flexible gas tubing,—a communication.

The above bear date July 15th.

1863. Stephen Dunmere, of John-street, Hampstead, impd. mattress and palliasse for the use of the nursery, invalids, or hospitals.

1864. Richard Archibald Brooman, of Fleet-street, impts. in pumps,—a communication.

The above bear date July 17th.

1865. Joshua Thornton, of Cleckheaton, impts. in means or apparatus for opening and straightening wool, cotton, and other fibres.

1866. John Paul Baugh le Patourel, of Calcutta, impts. in ventilators.

1867. James Armitage, of Bury, Huntingdonshire, impt. in drills for sowing seeds and depositing manure.

1868. John Pusey Wint, of Kensington-square, impts. in instruments used in cutting the soles of boots and shoes.

1869. Andrew Barclay, of Kilmarnock, impts. in steam boilers or generators.

1870. Timothy Ward Wood, of Newark-upon-Trent, impts. in the construction or arrangement of sluices or dams.

1871. William Antil Richards, of Clarence-road, Holloway, impd. pouch or receptacle for holding tobacco and other similar purposes.

The above bear date July 18th.

1872. John Batkin Whitehall, and Thomas Pillings, both of Nottingham, impts. in straight-eye clearing guides or cleaners, for winding silk, cotton, or other fibrous substances.

1873. Anson Henry Platt, of Philadelphia, U.S.A., the use and application of paper, printed or otherwise, ornamented with water colors, for covering floors and other analogous purposes as a substitute for carpets and oil cloths, and of an improved coating or varnish to be applied to the same

to protect its surface from injury and wear.

1874. Johann Ernst Friedrich Ludeke, of Stonefield-street, Islington, impts. in motive power by capillary attraction.

1875. Thomas Metcalf, Henry Metcalf, and Thomas Clayton, of Manchester, impd. apparatus for cooling liquids and cooling or condensing vapours or gases.

1876. Mark Knowles, of Blackburn impts. in looms for weaving.

1877. Donald McCrummen, of Gourock, N.B., impd. process of preparing sea-weeds and other vegetable substances for the production of artificial guano, felt, alkaline salts, and iodine.

1878. Constantine Henderson, of Parliament-street, impts. in the mode of connecting rails for railways and tramways.

1879. Charles Nicholas, of Cheltenham, impd. apparatus for supplying disinfecting liquids to water closets, urinals, and other places requiring the same.

1880. Joseph Grindley Rowe, of Queen-square, Westminster, impts. in signal and alarm apparatus for railways and railway trains.

1881. Henry Ernest Gilles, of Old Broad-street, City, impts. in processes and machinery for producing fibres, suitable for being spun from rags or remnants of woven or other textile fabrics made of silk, wool, cotton, or other fibrous materials.

1882. David Caddick, of Ebbw Vale, impts. in the construction and working of furnaces for puddling, balling, heating, and melting metals.

1883. William Edwards, of Birmingham, impts. in protecting crinoline steel, stay busks, springs for leggings or gaiters, and other similar fastenings.

1885. George Nimmo, of Jersey City, impt. in the mode of uniting different metals such as iron and copper or alloys to form compound metallic castings.

1886. James Miles, of Roslyn House, Hampstead, impts. in vermin traps.

1887. Thomas Henry Ince, of the Westminster Palace Hotel, impts. in shoeing horses.

The above bear date July 19th.

1888. Charles Rosson, of Birmingham, impts. in portable charge holders for breech-loading guns whether single or double barrelled, as also in the means of manufacturing the said holders, and in exploding the charge.

1889. William Tranter, of Birmingham, impts. in fire arms and in cartridges for the same.

1890. Cortland Herbert Simpson, of Bexhill, Sussex, impts. in apparatus for propelling vessels.

1891. Henry Augustus Clum, of Rochester, U.S.A., impd. instrument for indicating atmospheric changes.

1892. Thomas Swinburne, of South-square, Gray's-inn, impd. mechanism for propelling, driving, and forcing purposes.

1895. Ralph Smyth, of Hastings, and Wardle Eastland Evans, of Market-place, Great Portland-street, impts. in organs and harmoniums and similar keyed instruments.

1897. Morgan Lawrence Parry, of St. Paul's - churchyard, improvements in condensing apparatus for steam engines.

The above bear date July 20th.

1899. Saint John Vincent Day, of Glasgow, impts. in the propulsion of ships, and in the machinery or apparatus connected therewith,—a communication.

1900. Louis Alphonse Maurice Chaulin, of Paris, impd. process for rendering wood incombustible.

1901. George Taylor, of Heywood, Lancashire, and Joseph Crossley, of Bury, impts. in covers for rollers used in spinning cotton.

1902. James Walton, of Willenhall, impts. in locks, and in latch-bolts for locks and latches.

1903. Richard Mott Wanzer, of Cheapside, impts. in sewing machines,—a communication.

1904. Alfred Smith, of Hackney, impts. in sewing machines.

1905. Jean Henri Chaudet, of Rouen, impd. system of manufacturing salts, sulphates, and acetates of chrome, and of applying them as mordants in dyeing and printing textile substances, both animal and vegetable.

1906. Edward Schaub, of Manchester, impd. sizing material to be employed

for sizing or dressing yarns preparatory to weaving,—a communication.

1907. Charles Gardner, of Dover, impts. in apparatus for cleaning windows.

1909. William Speakman Yates, of Leeds, and Arthur Freeman, of Manchester, impts. in machinery or apparatus for folding fabrics on to card boards or metallic plates for the purpose of hot pressing.

The above bear date July 21st.

1910. Edmund Perre, of Manchester, impts. in the method of obtaining motive power, and in apparatus connected therewith.

1911. William Diaper, of Tabernacle-walk, Finsbury, impts. in the construction of safes or strong receptacles for the protection of property.

1912. George Wilson and James Goodfellow, of Glasgow, impts. in bedsteads, sofas, and chairs.

1913. William Edward Newton, of Chancery-lane, impts. in the construction of valves for steam and other engines,—a communication.

1914. Joseph Pierre Gillard, of Paris, impts. in the manufacture of soda and carbonate of soda.

1915. Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, impts. in obtaining motive power when heated air or aëriform fluid is employed.

1918. William Edward Gedge, of Wellington-street, impts. in the means of, and apparatus for, raising water for agricultural and other useful and ornamental purposes,—a communication.

The above bear date July 22nd.

1919. John McGrigor Croft, of Abbey-road, St. John's Wood, impts. in rudders for steering ships or vessels.

1921. Richard Archibald Brooman, of Fleet-street, impd. instrument to be employed in examining and facilitating operations in the throat,—a communication.

The above bear date July 24th.

1923. Max Benjamin Schumann, of Manchester, impd. portable chamber or receptacle to contain aërated liquids, and the apparatus connected therewith, by which the flow of such liquid is regulated and measured.

1924. John Rigg, of Crewe, impts. in the construction of railway carriages.

1925. Louis Petré and Edward Samuel Tucker, of Stamford-street, impts. in ornamental tables and table stands, such as cruet frames, liqueur frames, flower, egg, and other stands.

1926. Thomas Jefferson Mayall, of Roxbury, U.S.A., impts. in parts of military and other outfits.

1927. Martyn John Roberts, of Pendarren, Brecknockshire, impts. in means or apparatus for producing friction or adhesion between pulleys, rollers, and the like, and cords, bands, belts, or chains passed over or round them.

1929. John Juckes, junior, of Armagh-road South, Old Ford, and John Swinburne, of Wenlock-street, City-road, impts. in locomotive boiler furnaces.

1930. Henry Wright, of Goodge-street, Tottenham-court-road, impd. shank for buttons, studs, and solitaires.

1931. John Henry Johnson, of Lincoln's-inn-fields, impd. mode of lacing boots, shoes, and other articles united by laces,—a communication.

1933. Astley Paston Price, of Lincoln's-inn-fields, impts. in the manufacture of carbonate of ammonia, and in the utilization of the product obtained in such manufacture,—a communication.

The above bear date July 25th.

1934. Michael Kenney, of Dublin, impts. in the construction of sliding or rolling bridges.

1936. William Richards, and Joseph Richards, of Oldbury, Worcestershire, impts. in the manufacture of sal-ammoniac.

1937. Jules Belicard, the younger, of Paris, impts. in the manufacture of velvets, plushes, and other pile fabrics, and in the machinery or apparatus connected therewith.

1938. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in apparatus for burning combustible and volatile liquids for generating steam and similar purposes,—a communication.

1939. Edward Spicer, of New Bridge-street, Blackfriars, impts. in compositions similar to gunpowder, for blasting, for use in ordnance and fire arms, and for other purposes,—a communication.

1940. Samuel Lusty, of Walworth, impts. in fluid meters.

1941. Alfred Vincent Newton, of Chancery-lane, impts. in sewing machinery,—a communication.

1942. William Edward Newton, of Chancery-lane, impts. in machinery for planing metals,—a communication.

1943. Frederick Pulman, of Whitehall-yard, and Richard Ginman, of Woolwich, impd. composition for coating ships' bottoms and the surfaces of other vessels or structures which are exposed to the action of sea-water.

1944. William Barton, of Boston, impts. in the construction of cooking stoves and ranges.

1945. Jean Jacques Samuel Wenk and Alexandre Alphonse Mathieu, of Paris, impts. in apparatus for preventing accidents on railways.

The above bear date July 26th.

1948. Russell Mortimer, of Bush-lane, London, impts. in instruments for marking or impressing railway tickets.

1949. William Edward Newton, of Chancery-lane, impts. in bolt-screwing machines,—a communication.

1951. Alexander Cheffins, of Randolph-street, Camden-town, impts. in the construction of omnibuses.

The above bear date July 27th.

1955. Isaac Gregory, of Manchester, impd. means of communication by signals between passengers, guards, and drivers of railway trains.

1957. William Edward Newton, of Chancery-lane, impd. process for applying air-proof solutions to the interior of casks and barrels,—a communication.

1958. William Edward Newton, of Chancery-lane, impd. water meter, which may be employed as a water, steam, or gas engine,—a communication.

1950. Robert Brightmore Mitchell, of Bakewell, impd. break for railway and other wheeled carriages.

1960. William Cockburn, of Paisley, impts. in weaving ornamental fabrics.

The above bear date July 28th.

1961. Robert Clayton, of Pudsey, near Bradford, and James Raper and John Goulding, of Tong, near Bradford, impts. in looms for weaving.

1962. Frederick Augustus Abel, of the Royal Arsenal, Woolwich, impts. in compounds for waterproofing and insulating purposes.

1965. Alfred Augustus Larmuth, of Salford, impts. in machinery or apparatus for cutting the edges of paper hangings.

1966. Reuben Worsnop, of Bradford, impts. in cap frames.

1967. Valentine Baker, of Dublin, impts. in applying and utilising water power.

1969. John Swinburne, of Wenlock-street, City-road, and James Laming, of Lauderdale-buildings, Aldersgate-street, impts. in means or apparatus for stopping or retarding railway carriages.

The above bear date July 29th.

1974. Auguste Yves Rehm, of Paris, impts. in crinolines.

1976. Ephraim Sabel, of Moorgate-street, impts. in the manufacture of iron rails and girders,—a communication.

1977. John Lawson and Edward Gerrard Fitton, of Leeds, impts. in preparing machinery for flax, tow, jute, and other fibrous materials.

1978. Augustus Applegath, of Dartford, impts. in machinery for printing in colours.

1979. Alfred Vincent Newton, of Chancery-lane, imp. method of obtaining induced currents of electricity from magnets and induction coils,—a communication.

1980. Alfred Vincent Newton, of Chancery-lane, impt. in refining petroleum and hydro-carbon oils,—a communication.

1981. Alfred Vincent Newton, of Chancery-lane, impt. in ejectors for

discharging bilge water and for other purposes,—a communication.

1982. William Clark, of Chancery-lane, impts. in apparatus to be used in swimming,—a communication.

The above bear date July 31st.

1985. Thomas Bell Paton, of Montrose, N.B., impts. in machinery for the manufacture of linen or other yarns or threads.

1986. William La Penotiere, of Essex-street, Strand, impd. composition for coating the bottoms of iron and wooden ships, by which the same are preserved from fouling and the iron from corrosion, whether internally or externally, by sea or other water or moisture, which is applicable to iron of any kind exposed to the action of moisture.

1990. Louis Emile Constant Martin, of Adam-street, Adelphi, impts. in locomotive and other tubular boilers.

1992. Matthew Piers Watt Boulton, of Tew Park, Oxfordshire, in obtaining motive power by heat.

The above bear date August 1st.

1993. Alfred Ford, of Arthur-street, West, London, impd. method of forming india-rubber, gutta percha, or other such like balls.

1994. Henry Levy, of Glasgow, impd. means for testing alloys of gold.

1995. Thomas Andrew and James Whiley Taylor, of Commercial-street, Spitalfields, impd. mechanical arrangements or fastenings, applicable to the doors and cases of safes and strong rooms, for the purpose of preventing the opening thereof by wedges or levers.

1997. John Groves Teal, of Leeds, impd. apparatus for communication between passengers and guards in railway trains.

1998. John Crean, of East-road, City-road, and Charles Joseph Barr, of Chapel-street, Shoreditch, impts. in apparatus and means for giving alarm in cases of fire.

1999. Frederick Charles Dear, of Hertford, impts. in the means of communication between the passengers and guard and driver of a railway train.

2000. Joseph Pickin and Richard Bailey, of Congleton, Cheshire, impd. method of, and apparatus for, signalling and giving alarm on railways.

2001. Heiman Frankenburg, of Snow-hill, London, impts. in the construction of travelling and other bags.

2002. William Wharton Burdon, of Newcastle-upon-Tyne, impts. in reducing vegetable fibre to pulp, and in machinery employed therein.

2003. Richard Bailey, of Hoxton, and Joseph Eagland, of Hatton-garden, impd. fastening or lock.

2004. Charles Hodgson, of Portarlington, Queen's County, Ireland, impts. in, and apparatus for, treating peat in bogs, and obtaining it therefrom; also applicable to tilling and cultivating land.

2005. William Henry Petitjean, and Edward McNally, of Manchester, impts. in the construction of railway carriages, and in railway breaks and signals, part of which is applicable to marine purposes.

2006. Herbert Allman, of Ampthill-square, impts. in burglar-proof safes.

2007. John Henry Tyler, of Bermondsey, impts. in apparatus used in rolling leather.

The above bear date August 2nd.

2009. Edward Samuel Horridge, of Cheltenham, impts. in signals for railways.

2011. William Henry Brookes, of Rock Ferry, Cheshire, impts. in the means of fastening or securing the tongues or reeds of fog horns.

2013. William Morgans, of Brendon Hills, Somersetshire, impts. in coke ovens and in the manufacture of coke.

2015. Ernest Leslie Ransome, of Ipswich, impts. in paints or preparations for coating surfaces.

2017. Luke Anderson, of Newtown, Worcestershire, impts. in machinery to be used in the manufacture of horseshoes, shoe heel, and toe-tips, and other similar articles.

The above bear date August 3rd.

2019. Patrick Robertson, of Jeffrey-square, St. Mary Axe, impts. in brewing and distilling, also in drying yeast and in the apparatus employed.

2021. William Clark, of Chancery-lane, impts. in apparatus applicable as a motive power engine, a pump, or fluid meter,—a communication.
2023. Jean Adolphe Leon, George Tessimond, and John Kissack, of Liverpool, impts. in apparatus for filtering sugar and other liquid solutions.
2025. Frederick George Mulholland, of Swan-street, Dover-road, impts. in the mode or method of preparing materials for, and in the manufacture of, submarine telegraphic cables; the same being generally applicable for other purposes.
2027. Henri Adrien Bonneville, of Paris, impts. in revolver pistols,—a communication.
2031. Alfred Vincent Newton, of Chancery-lane, impt. in gun wipers,—a communication.
2033. George Baldwin Woodruff, of Cheapside, impts. in the construction of binders for sewing machines.

The above bear date August 4th.

2035. Samuel Buxton, of Leeds, impd. numerical registering machine.
2037. Thomas Smith and John Brook, of Rodney, near Leeds, a self-acting coupling for railway carriages and waggons.
2041. Cortland Herbert Simpson, of Bexhill, impts. in apparatus for sustaining and lowering ships' boats.

The above bear date August 5th.

2045. John Mead, of Abridge, Essex, impd. means or apparatus for retarding or stopping railway carriages and trains.
2047. Louis John Crossley, of Halifax, impts. in electric telegraphic apparatus,—a communication.
2049. Alfred Vincent Newton, of Chancery-lane, impd. mode of, and apparatus for, facilitating the transportation and delivery of letters, newspapers, and other freight,—a communication.
2051. Matthew Piers Watt Boulton, of Tew-park, Oxfordshire, impts. in generating steam, and in heating steam and aëriform fluids.

The above bear date August 7th.

2053. James Buchanan, jun., of Barrhead, Renfrew, N.B., and Robert Boyd, of Glasgow, impts. in printing and dyeing yarns and fabrics of cotton or other vegetable materials.
2055. Thomas Goode Messenger, of Loughborough, portable machine or apparatus for the cutting of screw threads on pipes or on solid materials, and for the cutting of pipes asunder.
2057. James Gale, jun., of Plymouth, impts. in preparing and treating gunpowder in order to render the same unexplosive and to protect it from damp.

The above bear date August 8th.

2061. Thomas Ramsden Shaw, of Pendleton, impts. in looms for weaving.
2063. Stephen Law and Joseph Law of Wolverhampton, impts. in breech-loading fire-arms.
2067. Barnabus Russ and Edward Gandell the younger, of Lambeth, impts. in the construction of sewing machines, particularly adapted for sewing sacks and bags.
2069. James William Longstaff, of Stratford, Essex, impd. mode of relieving slide valves of back pressure.

The above bear date August 9th.

New Patents Sealed.

1865.

48. Charles De Bergue.
170. D. Munro and T. Wright.
172. John Turney, jun.
183. Thomas Lester.
186. J. H. Wilson.
188. Jacob Snider, jun.
191. C. Brakell, W. Hoehl, and W. Günther.
194. Edward Atkinson.
201. M. A. Dietz.
202. Benjamin King.
215. S. L. Fuller, A. Fuller, and C. Martin.
221. George Haseltine.
226. A. A. Croll.
233. J. E. Massey.
237. James Hind.
238. Robert Helsham.
243. Joseph Turbill.
246. George Haseltine.
249. Victor Burg.
250. W. E. Newton.
252. John Raines.
253. William Clark.
254. Erastus Blakeslee.
255. E. T. Hughes.
261. W. Teall and A. Naylor.
262. John Gibson.
264. George Carter.
270. W. H. Cox.
271. Michael Henry.
274. E. P. Colquhoun and J. P. Ferris.
275. E. P. Colquhoun and J. P. Ferris.
279. John Sainty.
281. J. and W. Mc Naught.
286. John Hughes.
287. C. A. Wheeler.
288. A. S. Stocker.
292. Charles Lungley.
293. John Maynes.
294. James Ball.
295. J. H. Johnson.
297. Thomas Routledge.
298. William Vale.
300. G. and D. Hurn.
301. B. L. Mosely.
303. Matthew Blank.
304. William Clark.
307. Frederic Row.
310. J. A. Phillips.
313. Edouard Hottin.
315. R. A. Brooman.
319. R. M. Alloway.
321. C. R. Markham.
322. Jabez Booth.
324. W. H. Latham and C. W. Latham.
325. R. A. Brooman.
326. Robt. Shaw.
328. Alex. Steven.
334. Henry Masters.
335. Constantin Henderson.
336. H. B. Barlow.
338. Chas. Lungley.
339. A. J. L. Gordon.
342. Romain di Bray.
343. J. B. Watters.
345. John Lake.
347. A. A. Larmuth.
349. Geo. Twigg.
351. Charles Field.
360. R. A. Brooman.
363. J. C. C. Halkett.
367. Milo Peck.
368. J. P. Lindsay.
370. A. V. Newton.
371. John Dale.
374. Evan Leigh.
376. Edward Lord.
379. H. W. Hart.
380. W. E. Newton.
382. Henry Emanuel.
384. D. H. Barber.
385. G. C. Haseler and J. B. Haseler.
386. John and James Porter.
387. C. Atherton and A. H. Renton.
388. Joseph Hall.
391. Wm. Crookes.
394. E. J. Hill.
395. John Cass.
396. A. V. Newton.
399. D. Barr, W. H. Page, and J. C. Newey.
401. R. W. Thomson.
402. L. H. G. Ehrhardt.
403. J. A. Pastorelli.
404. William Adams.
406. J. G. Tongue.
408. E. G. C. Welch.
415. W. F. Batho.
416. R. J. Jones.
417. George Whitton.
418. Alfred Fryer.
419. E. H. Newby.
420. John Trotman.
421. J. von der Poppenburg.
423. R. P. Barrett.

424. Jas. Purdey.
425. Benjamin Thompson.
426. Benjamin Thompson.
427. S. R. Freeman.
429. W. C. Ridings, sen.
430. A. V. Newton.
431. W. H. Brown.
432. Michael Lane.
433. Charles Lungley.
434. D. C. Pierce.
436. G. T. Humphris.
437. R. H. Emerson.
441. William Kirrage.
442. R. A. Brooman.
444. H. J. Pickard.
448. J. F. Hearsey.
449. F. A. Laurent, J. Casthelaz, and N. Basset.
450. Joseph Thompson.
451. Richard Smith.
452. R. Hill and R. Tushingham.
455. John Brown.
457. Wm. Clark.
462. P. E. Bidaux.
465. C. Brackell, W. Hoehl, and W. Günther.
469. James Graham.
470. William Robinson.
472. L. W. G. Rowe and A. Baab.
477. W. E. Gedge.
478. Joseph Cliff.
479. J. D. Nichol.
489. J. Keighley and R. Shephard.
493. Jasper Hulley.
494. John Dodgeon.
497. T. G. Webb.
498. John Carter.
499. G. N. Shore.
500. James Nicholas.
501. M. P. W. Bolton.
502. David Barr.
507. Samuel Whitfield.
508. W. S. Mappin.
509. George Haseltine.
510. J. G. Hughes.
511. Samuel Saville.
512. W. E. Newton.
516. J. Jacob and R. Pilzuyer.
517. W. E. Gedge.
522. James Howard.
523. S. W. Worssam.
526. James Hundy.
529. James Badcock.
534. Frederic Claudet.
561. William Clark.
569. J. B. Toussaint.
570. Samuel Whitfield.
583. Samuel Brooks.
590. W. E. Newton.
594. William Clark.
598. Sir J. S. Lillie.
603. H. A. Bonneville.
604. H. A. Bonneville.
606. J. H. Johnson.
607. J. H. Johnson.
609. D. and J. Morris.
615. W. E. Newton.
618. Edwin Pettit.
619. C. F. Varley.
645. A. C. Henderson.
654. William Clay.
657. Robert Mushet.
658. Emile Carchon.
699. James Atkins.
703. John Webb.
727. W. E. Newton.
739. Joseph Seaman.
743. A. V. Newton.
819. R. W. Morrell.
836. W. E. Newton.
893. W. M. Fuller.
913. A. V. Newton.
914. A. V. Newton.
937. P. J. Jamet.
973. Robert Maynard.
1028. R. A. Brooman.
1058. C. F. Cotterill.
1082. John Todd.
1146. J. F. C. Carle.
1185. W. E. Newton.
1218. W. E. Newton.
1219. W. E. Newton.
1233. G. T. Bousfield.
1308. J. R. Cooper.
1318. George Haseltine.
1319. Henry Ransford.
1368. Theodore Faucheux.
1371. W. Manwaring.
1380. E. A. Raymond.
1418. Henry Nunn.
1422. C. T. Möller.
1499. W. E. Newton.
1549. R. A. Brooman.
1568. George Haseltine.
1572. George Haseltine.
1594. Albert Robinson.
1595. George Haseltine.
1609. A. E. Brae.
1678. George Haseltine.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S

London Journal of Arts and Sciences.

No. CXXX, (NEW SERIES), October 1st, 1865.

THE BRITISH ASSOCIATION.

The recent meeting of the British Association at Birmingham was, as might have been expected, both as respects the numbers of Members and Associates assembled, and the variety of entertainment afforded them, an undoubted success. Whether its recent labours have furthered much the advancement of science (the ostensible object of the Association), is another matter, and not quite so susceptible of proof. Much, however, has been done towards popularizing science in the last thirty-five years, during which the British Association has existed, and no doubt a fair share of this progress is due to its teachings. But popular science, it will be said, is shallow, and produces small results; it suits this "age of veneer," by giving men an appearance of profundity, but it will not rear among us profound philosophers. This may be so, but we yet await the proof that "a little knowledge is a dangerous thing." We certainly consider it more harmless than a breadth of ignorance. Indeed, we think a most interesting chapter might be written on the proved uses of the possession of a little knowledge—for example, of geology to the engineer, of chemistry to the architect and painter, of mechanics to the musician, and of pneumatics to the mechanician. A summary of such facts would show that knowledge, of whatever kind, comes amiss to no man. If this be so, then here is the strongest argument for such gatherings as that which has lately taken place at Birmingham, where all sciences found their exponents and were brought under free discussion. It cannot be denied that by the greater number of the followers of science who assembled at that great centre of manufacturing industry, the meeting was regarded as a holiday; but, notwithstanding, there was enough of real work accom-

plished to serve as an apology for the feasting and *fêtes* which greeted them on all sides.

The organization of the British Association and its rules of procedure peculiarly adapt it, as we think, to bring out and disperse abroad facts that might otherwise linger in obscure nooks and corners, and do little or no good to any one. Placing at its head, as President, some man of mark, famous in some branch of pure or applied science, and giving him that position for one year only, ensures the production of a series of presidential addresses that will be, at least, commentaries of powerful and well-trained minds upon the scientific acquirements of the age, and that from a constantly shifting point of view.

How valuable such a continuous commentary must necessarily be will readily be understood when it is remembered that among the congratulatory notices of progress made we are constantly reminded how clumsily, in some respects, we have hitherto courted Nature, and that she is in consequence at present deaf to our suit. Then again, from the Presidents of Sections, who also hold office only for a year, addresses of a more precise and practical character are obtained, directing the students of the sciences which they respectively represent, to draw deductions from some new facts, or guarding them from rash inferences. Following the delivery of these addresses are the papers presented to the sections, and whose merits are as various as the subjects of which they treat, serving thereby the better to induce animated and profitable discussions.

It has been frequently remarked, that the tendency of the age is to divide labour, as a proper division of labour ensures economical results. Among the followers of science, as in those of other pursuits, this tendency obtains, and the progress of discovery seems to require that it should be so, in order that the votaries of a given branch of study may thoroughly master the accumulating facts of their science; but then the contraction of the mental vision consequent thereon is the greatest obstacle to the development of the imaginative faculty which gives us new discoveries. Facts of one hue, long and steadily gazed upon, will as assuredly maze the mental eye of the scientific student as does a brilliant hue the corporeal eye of the painter. He must turn away to something less attractive to clear his vision, and it is for men thus circumstanced that the British Association performs an important part. In a persistent course of experiments, directed to a given end, an experimental philosopher might, from ignorance of cognate subjects, overlook facts which have courted his attention, as Sir Humphry Davy did the electro deposition of metals, only troubling himself so far about

the matter as to notice the inconvenience to which he was put by the deposit of copper in his battery cells. The merest smattering of a science, or of an art, may be the means of awakening in the mind of a man who has made himself master of some cognate subject a train of thought that may lead to great results, and such a smattering attendance in the several sections of the British Association could not fail to give. If he gains nothing else he may, perhaps, learn that there are ready means at hand which will enable him to solve questions which have long perplexed him. Thus the little knowledge which the late Robert Stephenson had gained of chemistry served to suggest to him the application of volatilizable metals as his tests for ascertaining the temperature in the chimneys of his locomotives, with the view to modifying their construction. In like manner our astronomers, did they but know something of practical mechanics, might possibly find it desirable to recall some of the beautiful theories of the mechanism of the heavens, the truth of which has been proved to their entire satisfaction by heaps of unfathomable mathematical formulæ. The mingling of *savans* of various branches of science which these annual gatherings cause, both at the *soirées* and excursions, if not in the sections, where each is in courtesy bound to make a show of interest in his neighbour's pursuits, cannot fail to serve the cause of truth, and help to eliminate from our scientific creeds untenable dogmas, which are, we fear, as rife among so-called philosophers as among theologians. Again, our geologists, if they had but possessed some knowledge of chemical and electrical action, would certainly have been more cautious in propounding those theories of our earth structure which they have seen fit, from time to time, greatly to modify.

The address of Professor Phillips, the President of the Association, gives an admirable summary of the recent progress of science, and also a well-timed rebuke to those who find in the recently-discovered human remains, mingled with those of extinct species of animals, and in the traces brought to light, by ardent archæologists, of human habitations in the Swiss lakes and elsewhere, proofs of the great antiquity of man; and in the Darwinian theory of the "origin of species," a further proof of the unreliability of the Mosaic account of the creation. He says of these discoveries—"*First, let us be sure of the facts*, especially of that main fact upon which all the argument, involving immensity of time, really turns, viz., the contemporaneous existence of man with the mammoth of the plains, and the bear of the caverns." Without contending against the deductions of the enthusiasts, who are never so happy as when contesting some biblical statement, Professor

Phillips, after suggesting a series of inductive questions to the disciples of Darwin, says,—"Specific questions of this kind must be answered before the general proposition that the forms of life are indefinitely variable with time and circumstance, can be even examined by the light of adequate evidence. That such evidence will be gathered and rightly interpreted I, for one, neither doubt nor fear; nor will any be too hasty in adopting extreme opinions, or too fearful of the final result, who remember how often that which is true has been found very different from that which was plausible." This is sound advice, which it behoves all scientific investigators to keep in mind. In vindication of the labours of the Association he says,—"If it be asked, what share in the discoveries and inventions of the last thirty-three years is claimed by the British Association? let us answer fearlessly, 'We had a part in all;'" and he refers to the annual reports, to justify this assertion.

It is a subject worthy of note, as illustrating the close connection existing between very different pursuits, and the action and reaction of one study upon another, that mechanical ingenuity has played a most important part in the advancement of abstract science. We have heard the superiority of modern instrumentation attributed mainly to the improved musical instruments which the more recent masters in the art of composition had at their command, in comparison with those of Handel's times. So also Professor Phillips acknowledges the debt which experimental philosophers owe to what he terms "the domain of practical art;" for, he says, "the admirable instruments of Whewell, Osler, and Robinson have replaced the older and ruder anemometers, and are everywhere in full operation to record the momentary variations of pressure, or sum the varying velocities of the wind." Also, "Our meteorological instruments of every kind have been improved." And again, "Our attempts to gain knowledge have brought back new facts and new laws of phenomena, or better instruments for attaining or better methods for interpreting them."

With respect to the business transacted by the Association, the papers read, and the discussions raised thereon, may be said to have been of good average interest. In sections F. and G. (Economical Science and Statistics, and Mechanical Science), which more immediately concern us, papers of considerable importance were brought under consideration. A selection from these we propose to publish, and others we may notice editorially, as occasion may serve. That most profitable subject for raising a lively discussion—patent law, was represented, or rather misrepresented, by Professor Rogers, of Oxford, who has yet to learn the rudiments of the question which he has now so frequently handled. A paper by Sir J. Burgoyne on the use of

Railways in War, prepared rather with the view of eliciting from railway engineers information as to the transit capabilities of railways, than of affording instruction thereon, created a lively interest. A paper entitled "Statistics of the Small Arms Manufacture of Birmingham," read by Mr. J. D. Goodman, an abstract of which we now publish, showed how extensively the government of the United States availed themselves of British industry, in furnishing their armies with fire-arms. Mr. Bessemer's paper on the Manufacture of Cast Steel, which we have also selected, gave rise to an interesting and profitable discussion. Other papers on subjects by no means new to engineers, as that of the Manufacture of Weldless Tyres, by Mr. F. J. Bramwell (included in our selection), and Siemens' Regenerative Gas Furnaces, by Mr. S. N. F. Cox, would seem to require an apology for their appearance, were it not for the acknowledged difficulty of forcing upon public attention things most obviously to their advantage to adopt. The "science of advertising," as carried on at the present time, is a proof of this difficulty. Witness the countless announcements which meet the eye in all directious of the "Daily Telegraph, the Largest Circulation in the World," and show plainly enough that the proprietors of a popular paper of unexampled circulation are still struggling against the general ignorance of its existence, or at least of its merits. The publicity which valuable inventions gain through these gatherings, and the opportunity afforded to visitors through the liberality of manufacturers to inspect the workshops of Great Britain, is of no small service to the country. Men of thought and men of action learn to appreciate and respect each other, and in this mutual appreciation an approach to assimilation takes place; the dreamers get visions of the practical, and the dry matter-of-fact men begin to feel within them the throbbings of imagination. By this means the British Association realises for us what the President has happily expressed as "the fair alliance of cultivated thought and practical skill." Long, therefore, may the Association labour to cement this union, for, to borrow one more expression from the presidential address, "by it labour is dignified and science fertilized, and the condition of human society exalted."

Recent Patents.

To James Hartshorn *and* Joseph Gadsby, *both of Nottingham, for improvements in manufacturing lace in twist-lace machines.*—[Dated 28th October, 1864.]

This invention consists in the use of one warp and one (or more) bobbin threads acting as weft threads, with longitudinal warp threads. The longitudinal warp threads, and also the weft warp thread, are capable of being traversed diagonally; or the longitudinal warp threads, after working with one warp and bobbin threads as weft threads for a time, may be traversed and worked with the next or neighbouring warp and bobbin as weft threads; or, if preferred, the first warp weft thread may, as before stated, be traversed with the longitudinal warp threads, and made to act as a weft thread with a neighbouring bobbin thread in succession, as the form of the pattern desired to be made may require, the warp and bobbin weft threads being separately used for the production of purls on the sides of the band of such weaving. The peculiarity of the weaving is, that not only the warp threads which are used for the time as weft threads, but also the bobbin threads, which for the time are used as weft threads, are, at each time of acting as weft threads, used double,—that is, two thicknesses of the threads lie side by side in the same opening between the longitudinal warp threads; the weft threads of the bands, when desired, producing purls, which purls may be twisted.

Suppose the machinery used in carrying out this invention to be ordinary twist-lace machinery, fitted with a number of guide bars, or suitable means for moving the warp threads endways of the machine; and that the object is to make a single band of weaving formed of a suitable number of longitudinal warp threads with their warp and bobbin weft threads, and that ten longitudinal warp threads are employed, as a set of longitudinal warp threads besides the warp and bobbin weft threads, together with suitable lacing threads; also that the band of weaving is about to be formed in the space occupied by three neighbouring bobbin threads, the first of which may be called the left-hand lacing bobbin thread, the second the bobbin weft thread, and the third the right-hand lacing bobbin thread.

The order in which it is preferred to place the warp threads is as follows:—The back warp lacing thread is placed nearest the back combs; then come the warp threads necessary for the ground of the lace fabric; after these come the warp weft thread; then follow the longitudinal warp threads, which are divided into two parts, numbered respectively 1, 3, 5, 7, 9, and 2, 4, 6, 8, 10. The front lacing thread is placed between the longitudinal threads and the front combs; it should, however, be remarked, that the relative placing of the threads may be varied.

Assuming the machine to be in the position for producing the first

movement of the threads, all the warp threads will stand on the left-hand side the left-hand lacing bobbin thread.

No. 1 *motion, carriages in front combs.*—The back warp lacing thread moves three gates to the right hand. The warp weft thread moves two gates to the right hand. The longitudinal warp threads 1, 3, 5, 7, 9, move two gates to the right hand. The longitudinal warp threads 2, 4, 6, 8, 10, stand on the left-hand side the left-hand lacing bobbin thread. The front warp lacing thread stands on the left-hand side the left-hand lacing bobbin thread.

No. 2 *motion, carriages in back combs.*—The back warp lacing thread stands on the right-hand side the right-hand lacing bobbin thread. The warp weft thread moves two gates to the left hand. The longitudinal threads 1, 3, 5, 7, 9, stand on the right-hand side of the weft bobbin thread. The longitudinal threads 2, 4, 6, 8, 10, stand on the left-hand side the left-hand lacing bobbin thread. The front warp lacing thread stands on the left-hand side the left-hand lacing bobbin thread.

No. 3 *motion, carriages in front combs.*—The back warp lacing thread stands on the right-hand side the right-hand lacing bobbin thread. The warp weft thread stands on the left-hand side the left-hand lacing bobbin thread. The longitudinal warp threads 1, 3, 5, 7, 9, stand on the right-hand side of the bobbin weft thread. The longitudinal warp threads 2, 4, 6, 8, 10, stand on the left-hand side the left-hand lacing bobbin thread. The front warp lacing thread moves one gate to the right hand.

No. 4 *motion, carriages in back combs.*—The back warp lacing thread stands on the right-hand side the right-hand lacing bobbin thread. The warp weft thread moves two gates to the right hand. The longitudinal warp threads 1, 3, 5, 7, 9, stand on the right-hand side the bobbin weft thread. The longitudinal warp threads 2, 4, 6, 8, 10, stand on the left-hand side the left-hand lacing bobbin thread. The front warp lacing thread moves one gate to the left hand.

No. 5 *motion, carriages in front combs.*—The back warp lacing thread moves two gates to the left hand. The warp weft thread stands on the right-hand side the bobbin weft thread. The longitudinal warp threads 1, 3, 5, 7, 9, move one gate to the left hand. The longitudinal warp threads 2, 4, 6, 8, 10, move two gates to the right hand. The front warp lacing thread stands on the left-hand side of the left-hand lacing bobbin thread.

No. 6 *motion, carriages in back combs.*—The back warp lacing thread moves two gates to the right hand. The warp weft thread stands on the right-hand side the bobbin weft thread. The longitudinal warp threads 1, 3, 5, 7, 9, stand on the left-hand side of the bobbin weft thread. The longitudinal warp threads 2, 4, 6, 8, 10, stand on the right-hand side of the bobbin weft thread. The front warp lacing thread stands on the left-hand side of the left-hand lacing bobbin thread.

No. 7 *motion, carriages in front combs.*—The back warp lacing thread moves one gate to the left hand. The warp weft thread stands on the right-hand side of the bobbin weft thread. The longitudinal warp threads 1, 3, 5, 7, 9, stand on the left-hand side the bobbin weft thread. The longitudinal warp threads 2, 4, 6, 8, 10, stand on the right-

hand side of the bobbin weft thread. The front warp lacing thread stands on the left-hand side of the left-hand lacing bobbin thread.

No. 8 *motion, carriages in back combs.*—The back warp lacing thread moves one gate to the left hand. The warp weft thread stands on the right-hand side of the bobbin weft thread. The longitudinal warp threads 1, 3, 5, 7, 9, stand on the left-hand side of the bobbin weft thread. The longitudinal warp threads 2, 4, 6, 8, 10, stand on the right-hand side of the bobbin weft thread. The front warp lacing thread stands on the left-hand side of the left-hand lacing bobbin thread.

It is not considered necessary to enter into any description of making the ground of twist lace of the fabric, as the same is well understood, and such is the case in respect to the combining of the weavings therewith.

In the above description, simple or loop purls only are supposed to be formed from the warp and bobbin weft threads in connection with the band of weaving produced by such weft threads acting with the longitudinal warp threads, but if twisted purls be preferred, then the warp and bobbin weft threads are twisted together (allowing a sufficient number of motions for this process), and the purls thus formed are to be laced in the ordinary manner.

To James Dannatt, *of Sunderland, for an improved composition for preventing the fouling of the bottoms of ships and vessels, and for the preservation of the iron or wood of which the same are constructed.*—[Dated 26th October, 1864.]

This invention relates to the preparation of a certain chemical composition, to be applied to the exterior of the bottoms of wood or iron vessels, for the purpose of preventing the accumulation and adhesion thereon of worms, barnacles, and other living organisms and foul matter, and for preserving the wood and iron from decay.

The composition is formed of resin, tallow, and corrosive sublimate, the proportions of the several ingredients being approximately as follows:—Resin, ten-and-a-half parts; tallow, three-and-a-half parts; and corrosive sublimate, two parts; the same being intimately mixed together. The corrosive sublimate is the active agent in effecting the objects of the invention, the other ingredients being used only as media for its application, and to give the composition the requisite consistency and adhesive power; the proportions of resin and tallow may, therefore, be varied according to the circumstances under which the composition is to be employed. This composition is laid on to the bottoms of ships in the same way as paint, thus producing a coating on the surfaces thereof.

The patentee claims, "the formation and use of the said composition, or any mere modifications thereof, for effecting the purposes aforesaid."

To Edward Beanes, *of Argyll-street, for improvements in preparing or treating animal charcoal.*—[Dated 3rd February, 1864.]

This invention consists, first, in improving the properties of animal charcoal, by subjecting it to the following treatment:—Animal charcoal, prepared in the usual manner and made perfectly dry, is thoroughly impregnated with dry hydrochloric acid gas, which is allowed to remain in the charcoal until the lime, the carbonate of lime, and other alkaline and earthy matters contained in the charcoal have been converted into soluble chlorides. The charcoal is kept hot when necessary during the time it is being impregnated with the gas, in order to expel any water which may be formed in the charcoal during the process; because the water, if not got rid of, might cause the formation of liquid hydrochloric acid, which would act injuriously upon the charcoal. But in operating upon large quantities of dry charcoal the impregnation of it with the gas will cause sufficient heat to be evolved for effecting that object. The excess of gas is then expelled as much as practicable by heat, or by passing through the charcoal a current of hot or cold air. The chloride of calcium and other soluble chlorides are then dissolved out. After being thoroughly washed, the charcoal (which may or may not be dried) is then fit for use. Animal charcoal which has been used, or become deteriorated in its properties, may be subjected to the same process, and may be re-burnt in the usual way, either before or after being submitted to the process. The object of applying dry hydrochloric acid gas to the charcoal is to convert the lime and other earthy and alkaline matters in the charcoal into soluble salts without producing any important action upon the phosphate of lime contained in the charcoal; the excess of the gas, if any, remaining unneutralized in the charcoal, at the end of that process is expelled in the dry way before washing, for the purpose of avoiding the production of liquid hydrochloric acid, which might injure the charcoal.

To George Furness, *of Great George-street, Westminster, and* James Slater, *of Catherine-terrace, Lansdown-road, Lambeth, for improvements in the construction of dredging or excavating machines.*—[Dated 26th July, 1864.]

In Plate VIII., fig. 1 is a side elevation of excavating machinery arranged according to this invention. *a*, is a shaft which receives motion from the connecting rod of a cylinder *b*. This shaft *a*, carries a spur pinion, which drives a wheel c^1, on the shaft *c*, to which shaft is also fixed a pinion c^2, taking into a wheel d^1, on the shaft *d*. This shaft *d*, carries a pair of pentagonal wheels d^2, over which endless chains *e*, pass, and to these chains buckets *f*, are attached. The endless chains *e*, also pass round wheels *g*, carried by the telescopic jib or frame *h*, which is capable of being raised and lowered within the frame h^1, for the purpose of lengthening or shortening the chains *e*, and of giving a proper tension to those chains. When set, the frame is secured in the desired position by means of nuts h^2. As the buckets rise to the top

of the machine, levers or arms d^3, act to force inwards doors f^1, working on hinges f^2, (see fig. 2, which is a section of one of the buckets) thereby discharging the contents of the buckets into a shute, and thence into a waggon, barge, or other receiver. Stops f^3, limit the amount of motion to the doors f^1; the chains e, are also guided by passing round rollers j^1, j^2, carried by the frame j. The axle of the rollers j^1, is hollow, and is supported by standards, and through it the driving shaft a, passes, and is supported by the side framings. It is preferred that the boiler and engine be carried by the same framing, but motion may be given to the machinery by a portable or other engine. Transverse motion is given to the machine by means of wheels j^4, running on rails l^1, carried by the lower carriage or traveller l, and longitudinal motion is given thereto by means of suitable gear applied to the lower carriage or traveller l, as is well understood; or the machinery may be applied to a barge or vessel. When at work, the jib or frame h, may be in a vertical or oblique position, and may be caused simply to rest against its work, or held up thereto by means of chains actuated by a "crab," or by other suitable means.

The patentees claim, "the combined arrangement of dredging or excavating machine, as shown and described."

To Alfred Vincent Newton, *of Chancery-lane, for improvements in the mode of, and machinery for, manufacturing telegraphic cables,—being a communication.*—[Dated 23rd September, 1864.]

This invention relates to a novel mode of enclosing and separately insulating several telegraph wires or conductors within one cable. The principal feature of this invention consists in a novel construction of, and mode of applying, an insulating piece of gutta-percha, india-rubber, or other material or fabric which is a non-conductor of electricity, whereby the said piece is made to serve both as a central core for the separation of the several wires or conductors, and an envelope for enclosing the same, each wire being thereby insulated from the others, so that it may be used as a separate conductor. This insulating piece is represented in Plate VII., at figs. 1, 2, 3, and 4, which are transverse sectional views; figs. 1 and 2 showing its condition before application, and fig. 3 showing it applied in a cable. It is composed of a core a, having a number of longitudinal fins or flanges b, b, corresponding with the number of wires or conductors to be enclosed. It may be made of india-rubber or gutta-percha by forcing such material in a plastic state through a suitable die with the fins or flanges radiating from the central core, as shown in fig. 2, or be produced by taking a strip of gutta-percha or vulcanized india-rubber of suitable thickness, and slitting it, with a suitable cutting instrument, as shown at c, c, in fig. 1, to within a suitable distance from the centre, to form the fins or flanges b, b, or by taking strips of woven fabric and sewing them together along their centres, and afterwards saturating and coating them with gutta-percha, india-rubber, or other insulating material or composition. The wires or conductors e, e, are placed between the fins or flanges, which are afterwards

turned over the wires and made to envelope and enclose them separately, as shown in figs. 3 and 4. The enveloped conducting wires are secured by one or more coverings of wire, cord, yarn, or tape, as shown at *r*, *r*, in figs. 3 and 4, or with coverings of all or any number of those fabrics; also as many coatings of flexible airproof and waterproof materials, compositions, or varnishes are applied as may be deemed necessary. Fig. 3 represents the insulating piece as covered with a single cord; and fig. 4 represents it covered with several layers of cord, tape, and wire.

The invention also consists in machinery for the manufacture of a cable, in which an insulating piece, such as is above described, is used. Fig. 5 is a central longitudinal vertical section of a train of machinery for the manufacture of such a cable. At the extreme left of this figure there is represented a frame T, with radiating arms, to which are attached the bearings for the spindles of a number of spools U, U, from which the conducting wires *e*, *e*, are supplied. At the right of the frame T, there are represented, arranged in a suitable standard A, two pairs of rollers *f*, *f*, through which the insulating piece is first passed, two of its fins or flanges *b*, *b*, passing between the upper and lower rollers, and one through the space left between the two upper rollers, and one through the space left between the lower rollers. The insulating piece passing from these rollers meets the wires *e*, *e*, in a stationary die B, which is supported in a standard D. Fig. 6 is a front view of this die. The opening of the die is made of a suitable form, for the passage of the insulating piece, and with suitable grooves *i*, *i*, in the central portion *h*, of the opening between the radiating portions *j*, *j*, through which the fins or flanges *b*, *b*, of the insulating piece pass. These grooves are for the passage of the wires or conductors *e*, *e*, which are brought thereinto from the spools U, U. From the die B, the insulating piece and the conductors *e*, *e*, pass through a hollow mandril E, which has a taper or funnel-like entrance. This mandril has a rotary motion in bearings in the standard D, and by this rotary motion it is caused to turn the fins or flanges *b*, *b*, of the centre piece over the wires or conductors *e*, *e*, in the manner shown in fig. 4, and make them envelope the said wires or conductors. From the rotating hollow mandril E, the insulating piece and enveloped conductors pass through the hollow spindle F, of a rotary flyer G, the said spindle being arranged in line with the hollow mandril E, in a bearing or bearings in the fixed standard H. Within this flyer G, there is arranged a bobbin I, fitted to rotate freely upon the spindle F; this flyer carries wire, cord, or yarn, which passes therefrom over guide pulleys *k*, *k*, in the sides of the flyer, and through fixed guides *l*, *l*, in the end thereof, and is wound by the rotary motion of the flyer around the insulating piece and enveloped conductors as they issue from the hollow spindle F, through which they pass, and thus the wire, cord, or yarn is made to confine the fins or flanges lapped around the conductors. From the flyer the now partly-formed cable, composed of the conductors, insulating piece, and surrounding coil of wire, cord, or yarn, passes through the hollow spindle J, of a second rotating flyer K, which is fitted to rotate in bearings in standards S, S. Upon the spindle *p*, which forms one side of this flyer, there are arranged two spools *m*, m^1, which carry cords, yarns, or wires, or one a wire and the other a cord

or yarn, and upon the spindle q, which forms the other side of the flyer, is arranged a spool n, carrying a tape. The revolution of this flyer first causes the spool m, to wind a cord, yarn, or wire upon the cable; it then causes the spool n, to wind upon this covering a tape, and it afterwards causes the spool m^1, to wind a cord, yarn, or wire outside of the tape covering. The spindle q, is capable of adjustment at different degrees of obliquity to the main spindle J, to allow the tape to run on to the conductor at any desired angle. From the hollow spindle J, of the flyer K, the cable passes through a stationary vessel L, containing melted or dissolved india-rubber, gutta-percha, or other suitable material or cement, which, when set, is impervious to air and water. Under this vessel there is arranged a lamp L^1, by which the contents of the vessel are kept in a melted state. This vessel is suspended on the hollow spindle J, at one end, and on a hollow journal J^1, at the other end, opposite the spindle J, or otherwise so supported that it will not rotate; and around the opening sin it sends, through which the cable enters, there is a suitable packing t, t^1, the object of which is to prevent the leakage of its contents. From the said vessel the cable passes through a vessel M, containing cold water, the object of which is to cool and produce the hardening of the coating which has been applied in the vessel L, and the inlet and outlet through which the cable enters this vessel are fitted with suitable packing, as shown at u, u^1, to prevent the leakage of the water. The outlet through which the cable leaves the vessel L, is so constructed or lined, or its packing t^1, so applied as to wipe or take off any superfluous coating material or cement from its surface. From the water vessel M, the cable passes through the stationary hollow axle Q, upon which rotates a hollow rotating pulley P, in which are arranged spools R, R, from which a covering of wire or cord is wound upon the cable by the rotation of the said pulley. For a submarine cable it would be desirable to have this covering of wire to form an armour, but for a cable to be suspended in the air, a covering of cord or yarn would serve very well, if afterwards coated with a waterproof varnish or cement. The cable may be drawn through the covering machinery by means of take-up, drawing, or feed rollers, suitably applied in front of the pulley P; and also, if necessary, at other points in the train of machinery.

It may be desirable to apply outside of the insulating piece, or outside of a coating of cord or yarn coiled around it, a covering of armour, composed of longitudinally-arranged wires. These may be conducted to it by any suitable system of guides from suitably-arranged spools or coils, but generally in such case it is proposed to conduct the wires from a system of spools similarly arranged to those shown in fig. 5. The armour wires may be arranged helically about the cable by giving the frame T, which carries the spools U, from which the wires are supplied, a rotary motion, for which purpose the frame is attached to a hollow central rotating shaft T^1. When the cable is to be manufactured with armour wires, the conducting wires may pass through the hollow shaft T^1. The frame T, is represented as furnished with guides w, w, through which the wires pass on their way from the spools U, U, and by which any short bends in the wires are taken out.

The die represented in fig. 6 is constructed for an insulating piece

for four conductors, such as is represented in figs. 1, 2, 3, and 4; but the number of conductors in a cable may be varied, and this variation requires a corresponding variation in the form of the insulating piece and in the number of radiating grooves *j*, *j*, and intermediate grooves *i*, *i*, in the die B.

The patentee claims, "First,—the employment for separating and independently insulating several wires or conductors in a telegraph cable of an insulating piece. Second,—the system of rollers *f*, *f*, for conducting the insulating piece to where it receives the conductors. Third,—the stationary die B, constructed, applied, and operating substantially as herein set forth. Fourth,—the arrangement and combination of parts constituting a train of machinery, commencing with the rotating hollow mandril E, and ending with the revolving spool pulley P, for covering conducting wires and overlaying telegraph cables, substantially as and for the purpose herein described."

To WILLIAM ROBERT SYKES, *of Pimlico, for improvements in apparatus for transmitting positive and negative currents of electricity.*—[Dated 14th October, 1864.]

THE figure in Plate VII. is a front elevation of the improved apparatus for transmitting currents of electricity. To a frame *a*, *a*, is fixed what is termed a top metal plate *b*, and it is put always in communication, by means of a wire *c*, with the negative pole of a battery. On another part of the frame *a*, *a*, is fixed a metal block *d*, hereafter called the bottom block, with two points of contact *e*, *e*, and it is put constantly in communication by a wire *f*, with the positive pole of a battery. From the top plate *b*, carried by projecting brackets *g*, *g*, depend two metal studs *h*, *h*. At the back part of the frame *a*, *a*, are fixed two metal standards, one being in communication with the earth, and the other standard with a line wire *l*, which leads to an ordinary signalling apparatus. To each of the two standards are attached the back ends of a double leaf or tweezer spring *m*. The open and inner ends of these springs project over the points of contact *e*, *e*, of the bottom metal block, but do not touch them. When the instrument is at rest, the upper leaves of the tweezer springs rest against the under surface of a metal cross head *n*, affixed on the inner end of a shaft *o*, which passes through the front frame of the apparatus, and which carries the handle *p*, whereby the instrument is worked. On putting the handle *p*, on one side it brings one end of the cross head *n*, down upon one end of one of the tweezer springs *m*, and forces both leaves of that spring in contact with the bottom block *d*; at the same time, the other end of the cross head being raised, allows of the upper leaf of the other tweezer spring *m*, making contact with the metal stud *h*, above it, and depending from the top metal plate *b*. Thus, by turning the handle *p*, to one side or the other, positive or negative currents are transmitted.

The patentee claims, "constructing apparatus for transmitting positive and negative currents of electricity with a top metal plate, bottom block, tweezer springs, and cross head, arranged and acting substantially as described."

To Frederic Newton Gisborne, *of Adelaide-place, London-bridge, for improvements in the means of working electric signals for gunnery practice.*—[Dated 1st October, 1864.]

The object of this invention is to enable the person in command of a ship to transmit orders from his position above deck to the officer or person in charge of her guns in the battery below, after firing, loading, or otherwise, or to the engineer.

In Plate VIII., fig. 1 is the captain's communicator; *a**, being the handle; *b**, the pointer, under the face *c**; *d**, the dial face, upon which the orders are painted or marked; *e**, the revolving wheel, which makes side contact with the segments of the circle *f**; *g**, being a ratchet pin, for preventing any backward movement of the pointer; *h**, a circuit break knob; and *j**, an electro-magnetic bell. Fig. 2 is a vertical section of the communicator, showing the circle in segments and the revolving wheel *e**. The smaller segments *k, k, k*, are connected up as one contact, as are likewise the larger ones *l, l, l*; the battery wire being attached to the wheel. Fig. 3 is an end view of the indicator: *a, a*, being the electro-magnet; *b*, the armature; *c*, a small roller at the end thereof; *d*, the revolving octagon; *e*, an escapement lever; *f*, a ratchet wheel; and *g*, a spiral spring; *h*, an electro-magnetic bell; *j*, a moveable pin shaft jointed to the bell armature.

The action is as follows:—One battery pole being attached to the smaller segments *k, k, k*, of the communicator's contact circle, the other to earth, and the line wire to the revolving wheel, a single current is allowed to pass over each segment *k*, that the wheel passes over. This current magnetizes the electro-magnet *a, a*, of the indicator, attracting the armature *b*, towards it. The roller *c*, then acts like a short lever upon the excentric escapement lever *e*, which flies up, and by the ratchet wheel *f*, causes the octagon *d*, to revolve half a tooth. The pointer, when at an order, causes the wheel which moves in unison with it to rest upon the larger segments *l, l, l*, of the communicator's circle, which breaks the current and releases the armature *b*, of the indicator. This allows the spring *g*, to depress the escapement lever *e*, which then by mechanical force completes the remaining half-tooth of space, and thus revolves the octagon one-eighth of its circumference. For each current one side of a polygon may be exposed to view. The ratchet pin *g**, of the communicator is simply to prevent back or false currents, it being evident that the communicator's contact wheel must rotate in unison with the octagon, in order to transmit correct orders. The moveable pin shaft *j*, assists the rapid movement of the octagon *d*, by pressing against it at each stroke of the bell, which, being in the same current as the electro-magnet *a, a*, acts in unison with it.

Fig. 4 is a side view of a contact box, showing the movements of an engine shaft. *a, b*, are two levers, jointed so that either one or the other may make contact upon the springs *c, d*, according to the directive movement of the body acting upon them; *e*, represents such shaft or body; and *f*, is the contact piece thereupon.

It is obvious that the octagon above described may be made to revolve by two magnets, in lieu of one magnet and a spring; also that contact may be made from a pin or excentric piece attached to the engine shaft, or to show the lay of a gun.

The patentee claims, "the combination and arrangement, substantially as described."

To James Mackay, *of Aighburth, near Liverpool, for certain improvements in projectiles to be employed in ordnance, and in the manufacture of the same.*—[Dated 27th September, 1864.]

This invention relates to a novel description of elongated projectiles to be employed in ordnance, whereby the unsteady movement usual in the flight of elongated projectiles is diminished, and also the projectile striking the object on end, that is, as near as possible in a line with its longitudinal axis, is insured. The improvements consist in so forming or shaping the elongated projectile that a certain length thereof (say, for example, one-third) shall be of less diameter than the remaining two-thirds, which occupies the bore of the gun, the exterior surface of the lesser and larger diameters both being in lines parallel to the axis of the projectile, and the junction between the two varying diameters is formed by a bevil or inclined shoulder, and both the ends or terminations of the projectiles are semicircular, the radii of the semicircles being half of either diameter, and the centres thereof being upon the line of axis. In order to balance the projectile, if desired, from the centre of its length, a small portion of the front semicircle may be removed.

The figure in Plate VIII. represents a side view of one of the projectiles, showing the larger diameter *a*, which bears upon the bore of the gun and its semicircular end, and the lesser diameter *b*, and its semicircular end, which diameter is consequently somewhat less than the bore. A portion of the front end, or that nearest the muzzle of the gun, may be cut away in order to balance it, if desired.

In manufacturing the projectile of wrought metal or steel, the bar of metal is first cut off to about the weight and length required; it is then hammered or "swaged" when heated (by any heavy hammer) in a horizontal position, the hammer head and anvil being each formed like half the projectile as a "swage," or the bar may be swaged in lengths for a number of projectiles, and afterwards cut to about the length and weight required. After this it is to be re-heated and placed in a vertical die box, in the form of vertical half of the projectile, and having an opening at the bottom, through which the surplus metal is pressed when the hammer or hydraulic pressure is exerted on the upper half of the die box. By this means the metal is densified in proportion to the pressure employed, and when the pressure has been sufficiently great, no further hardening is necessary for steel projectiles. When the projectile is thus far advanced, it is cooled as rapidly as possible, and may then be centred in a lathe, and the whole exterior, or the part bearing on the bore of the gun, may be polished, in which state it may be heated again and tempered or not, as may be requisite.

When forming these projectiles in cast metal, they may be cast in metallic moulds as usual.

To George Bishop Cornish, *of New York, U.S.A., for improvements in applying copper, "yellow metal," or other metal sheathing, to iron or steel ships and other navigable vessels built of iron or steel.*—[Dated 27th September, 1864.]

This invention consists, first, in applying a sheathing of wood to a ship's bottom, and attaching the same thereto by means of screw bolts and nuts or headed bolts which pass through the planking and skin of the vessel, and, where convenient, also through the frame of the vessel. When the bolts are to be rivetted, they should be driven from the exterior, and rivetted on the inner surface of the skin or frame of the vessel, care being taken in this case, as well as when screw bolts and nuts are used, to countersink the heads on the outside, and then cover them with wooden plugs, cement, or other suitable material, so that no portion of the bolt head will be exposed. The seams are then caulked, sheathed with tarred paper, felt, or other suitable material, and the copper or other sheathing is applied by means of nails, in the ordinary way.

In some cases it is preferred to attach the wood sheathing by means of screw bolts from the interior, in which case holes should be tapped in the metal skin of the vessel, and the bolts formed with a thread the whole length of their shanks.

In this modification, when applying the planking, it will be requisite to have it in close contact with the skin of the vessel previous to inserting the binding screws, as these screws will have no drawing property, in consequence of the thread of the screws taking into the threads formed in the holes through the skin of the vessel; but the object in screwing the bolts through the skin of the vessel is, that should the wood sheathing, by accident, be carried away, and the ends of the bolts broken, the holes through the skin of the vessel will be effectually closed, as the bolts being screwed therein cannot drop out. In this last modification no metal will be exposed externally, as the screwed bolts do not pass entirely through the planking.

In Plate VII., fig. 1 is a vertical section of a portion of a vessel's bottom, showing the wood sheathing attached thereto by bolts and nuts; fig. 2 is also a portion of the vessel's bottom, showing the improvements attached thereto by means of rivetted bolts; and fig. 3 is a like section, showing the improvements attached thereto by screw bolts from the inside of the vessel. *a*, is the frame of the vessel, shown broken off; *b*, the outer skin or plating of the vessel, which is, say, half an inch thick; *c*, the wood planking or sheathing of, say, two inches thick; *d*, a sheathing of paper, felt, or other suitable material between the plating of the vessel and the inner surface of the wood sheathing; *e*, felt or other sheathing below; *f*, the copper, "yellow metal," or other external metal sheathing; *g*, (fig. 1) bolts and nuts, the heads of which are countersunk, and covered by wooden plugs, cement, or other suitable material *h*; *k*, (fig. 2) rivets, the heads of which are also countersunk, and covered with wooden plugs, cement, or other suitable material; *l*, (fig. 3), headed screws, which are applied from the interior of the vessel.

The patentee claims, "applying copper, 'yellow metal,' or other metal sheathing, to iron and steel ships and other navigable vessels, in the manner and for the purpose described."

To Alexander Monro, *of Glasgow, for an improved mode of, and apparatus for, heating steam boilers.*—[Dated 4th October, 1864.]

This invention consists in communicating the heat to the boiler through the medium of a substance which is fluid at the working temperature, but which does not readily evaporate or become decomposed, whilst it is capable of supplying the necessary heat without being so hot as to injure the boiler shell. For this purpose lead is applied between the fire and the boiler proper, by putting it in a bath, jacket, or shell of a form adapted to whatever class of boiler may be used.

In Plate VIII., figs. 1 and 2 are longitudinal and transverse vertical sections of a steam boiler suitable for use on land. The boiler comprises a horizontal cylindrical portion 1, above, and communicating with which by three connections 2, is a horizontal cylindrical steam chest 3. The boiler proper 1, somewhat resembles a common internally fired two-flued boiler, but with the bottoms of the two flues united and forming a U-shaped flue 4, 5, the front end 4, of which forms the furnace. This flue 4, 5, is surrounded by two shells, which separate it from the water, and the space 6, between these two shells is to be filled with lead, which can be introduced in a melted state by pipes 7, provided for the purpose. It is preferred to have the space 6, containing the lead, as much as possible in actual contact with the fire, that is, with the ignited fuel, so as to receive the heat directly therefrom instead of receiving it from gases, which, from their rarefied condition, can supply it but imperfectly. With this view ducts 8, are formed through the upper part of the boiler 1, so as to communicate with the tops of the vertical parts of the U-shaped flue or furnace space 4, and the coals can be introduced by these ducts, and can be maintained at as great a height as may be found desirable in practice. The cooling ducts 8, are fitted with doors, whilst a vertical grating 9, is adapted to the front end of the furnace, and a series of plates 10, are fitted in front thereof, for the purpose of regulating the admission of air required for combustion. The coal rests on horizontal fire-bars 11, of the ordinary kind, and beneath these there is the usual ash-pit 12. The arrangement of the external flues is, in this example, supposed to be such that the gases leaving the back end 5, of the internal flue, diverge and pass forwards along the sides, and then, descending, return by bottom flues to the chimney 13.

Fig. 3, is a section of a marine boiler, fitted with a lead bath according to this invention. An internal furnace space 4, occupies the lower part of the boiler 1, and the gases rising from the back thereof return through the usual tubes to the chimney. The roof of the furnace space is made of a deeply-undulated form, to give extended heating surface, and the roof and sides are made with two shells, with a space 6, between them, which space is to be fitted with lead as in the former example. The other parts also are similar and need not be further described. The patentee remarks that where the sides of the lead bath 6, are vertical, or slightly inclined, the heat will most probably be communicated in a way tending to induce or encourage such currents in the water as will be most favourable to the disengagement of the steam in a "dry" condition. Thus the action of the heat on the lead will probably cause it to rise on the side next the fire, and consequently

descend on the side next the water; whilst the water in rising will be continually coming nearer hotter and hotter portions of the descending lead, which will promote the upward current of the steam.

The patentee claims "the communicating of heat to steam boilers through the medium of a substance such as lead, which is fluid at the working temperature, in the manner and for the purpose described."

To HENRY SEPTIMUS COLEMAN *and* ALFRED GEORGE EDWIN MORTON, *both of Chelmsford, for improvements in the application of steam power to the cultivation of land, and in the rope drums used for such purposes.*—[Dated 8th October, 1864.]

THIS invention relates, first, to a novel application of two steam engines (one at each side of a field) in the traversing of two implements to and fro in tilling the land, such engines both operating simultaneously on the same circuit of rope or ropes by which the implements are propelled.

The invention relates, secondly, to a peculiar construction of drum or rigger for communicating the power from the engines to the traction ropes of agricultural implements, whereby endless ropes can be used, and at the same time a sufficient holding power is provided therein for the purpose required, the peculiar construction of drum permitting of the rope passing more than once round it.

In Plate VIII., fig. 1 is a diagram showing the improvements in the application of steam power to the cultivation of land. *a*, a^1, are the engines placed at the headlands. With the exception of the rope drum, they are of the usual construction, but may, of course, be each of less power than where only one engine is employed. *b*, b^1, are the two implements; *c*, c^1, are the ropes passing round the rope drums of both engines: these ropes are shortened or lengthened by taking up or letting out at the points where attached to the implements, and according to the distance apart at which the engines are disposed. The implement *b*, operates from the middle of the field to the engine *a*, on the left, and the implement b^1, operates on the land from the middle point to the engine a^1, on the right, the retrograde movement of the one implement taking place while the other is in work. The implement moving backwards does so in each case on the unbroken ground. The implement *b*, is represented as in work while implement b^1, is moving backwards. Each of the implements *b*, and b^1, is, of course, supposed to represent a combination of ploughs, scarifiers, or other instruments combined in one frame, as is well understood.

By this arrangement it will be readily understood that, with both engines working simultaneously, the power of engine *a*, for instance, will be transmitted directly to *b*, (the implement in operation) by the rope *c*, while the power of the engine a^1, will be transmitted directly to b^1, (the implement out of work) by the rope c^1, but which will be in excess of what is required for producing the retrograde motion thereof; the surplus power will consequently be transmitted by the rope to the drum of the engine *a*, round which it passes, and thence to the implement *b*, in work, and therefore utilizing the whole power of both engines. The engines are moved forward on the headlands in the

ordinary manner at such times as will cause the implements to be hauled in the directions necessary to traverse the implements in the lines desired.

Fig. 2 represents a transverse section of part of an engine boiler, having a rope drum arranged and constructed according to this invention; and fig. 3 is a transverse vertical section of the drum. It is mounted on a strong stud *d*, fixed on the under part of the body of the boiler, somewhat as usual. *e*, is the drum cast with a broad groove or face, in which the pinions *f*, *f*, are disposed, as seen; they are mounted on axes *h*, *h*, received in bearings *i*, *i*, in the arms or body of the drum. The drum is cast with a flange and inner ring of teeth *k*, in which a pinion *l*, takes, receiving motion from the engine by means of the shaft *m*, on which it is mounted, as well understood. The V-grooves in the pinions *f*, form the grooves in which the rope *c*, shown by dots, encircling the drum, lies, by which it is kept in parallel coils. The teeth of the pinions *f*, take into a stationary screw thread *p*, fixed on the bottom of the stud *d*, which controls the position of the pinions, and which by the rotary motion of the drum imparts a slow rotary motion to the pinions *f*, on their axles *h*, the amount of such motion being equal to the distance from one tooth to another of the pinions *f*. Thus the required position of the rope on the drum is uniformly maintained throughout its action, and as indicated in dots in fig. 2.

The patentees claim, "First,—the combination described, in which the power of two engines is applied to two distinct agricultural implements, in the manner described. Second,—the combination, arrangement, and operation of parts represented and described, with reference to figs. 2 and 3, constituting a hauling rope drum, and its application for the transmission of power applied to agricultural implements."

To WILLIAM GARDNER, *of Lever-street, St. Luke's, for improvements in iron safes for the preservation of property from robbery and fire.*— [Dated 10th October, 1864.]

IN Plate VIII., fig. 1 is a front elevation of the improved safe with the door closed; and fig. 2 is a plan of the same, partly in section. The door A, is formed of two iron plates *a*, bound together, with a space *b*, between them of one inch, more or less, according to the size and character of the safe. The outer plate *a*, has a lining *c*, formed of pieces of steel, kept in position by a central partition a^1, to resist the efforts of thieves, and the remaining space is filled with a suitable composition, preferably consisting of about equal proportions of charcoal, whiting, alum, and sawdust, to resist the action of fire. To the inside of the door A, is fixed an iron frame B. When the door is closed this frame fits into a chamber or recess C, the latter being formed by a frame D, fixed within the safe. This frame is secured to a frame E, rivetted to the sides F, of the safe. This construction of the door not only resists the action of fire and the efforts of thieves to bore through the door, and thus secure an entrance, but the frame B, fitting into the recess C, when the door is closed, prevents the latter being forced open by the introduction of wedges, or other implements, between the

plate *a*, of the door and the sides F, of the safe. This safe has two bottoms, G, and H, the former, G, being the fixed or ordinary bottom, with a dovetail groove on the under side thereof, and the latter, H, with a dovetail *d*, formed thereon, being moveable, the dovetail *d*, sliding in the groove formed in the plate G. This dovetail groove or channel extends from the door to the back, or from side to side of the safe. Instead of this groove or channel being formed in the shape shown, it may be of a T or other suitable shape, the object being to unite the two bottoms G, and H, firmly together. The two plates or bottoms G, and H, are prevented from sliding on each other by means of the screws *e*, passing through the former into the dovetail *d*, immediately under the door A; so that when the door is closed, the screw heads are covered over, and cannot be removed. Before the plates or bottoms are thus locked by the screws *e*, the bolts or screws *f*, are inserted through the holes in the plate H, and by means of the bolts or screws *f*, passing into the beams or girders. the safe is securely fixed. This construction and arrangement renders the removal of the safe by thieves almost impossible, and in case of fire. all danger to the contents by the penetration of hot air through the screw holes or other apertures for securing the safe is entirely avoided. By this arrangement also, the position of the holding-down bolts or screws may be so varied as to pass through the girders or other firm part of the flooring, without interfering with the internal parts of the safe, as has hitherto been the case.

The patentee claims, "the invention substantially as specified."

To THOMAS LAMBERT, *of Short-street, New Cut, Lambeth, and* HENRY CHARLES SOPER, *of Cleaver-street, Lambeth, for improvements in the manufacture of taps, cocks, or valves.*—[Dated 10th October, 1864.]

THIS invention consists in constructing the body or shell of a tap or cock of cast iron, and galvanized on the outer surface. With such a body or shell is combined a cone or plug, cast in a metal mould, known as Vaucher's metal, which is an alloy of zinc, tin, lead, and antimony. The plug goes into its place without being previously turned, which has always heretofore been necessary, as it is, when it leaves the mould, quite true in form and size, and a little grinding to smooth the iron shell is all that is required to make the tap quite tight. In this manner, in manufacturing taps or cocks, the labour of turning and finishing the cones or plugs is avoided, and a very durable article is produced.

In casting the cones or plugs, a metal mould is employed, made to receive at its ends the iron cross-head for the top of the cone or plug, and a screw for its lower end; this screw being to receive the nut which is to secure the cone or plug in its place in the body or shell. The mould also receives a metal core to form the waterway of the tap or cock, and being thus arranged, the metal is poured into it, and when it is taken out, the cross-head and screw are found firmly fixed in the cast metal when the core has been forced out of the waterway, and the "gate" or runner cut off the plug is ready for use.

Equilibrium cocks are now made in which the water or fluid enters a cylinder at about the centre of its length. A stem passes from end to end of the cylinder, and has at its end a valve shutting on a seat at the end of the cylinder; the stem also carries on the further side of the passage, by which the water or fluid enters the cylinder, a piston or cup leather fitting the cylinder, so that the pressure of the fluid on the cup leather just balances that on the valve, and allows the stem to be moved along in the cylinder to open the valve with a very small expenditure of force. The stem is guided by a portion at its end beyond the cup leather or piston being turned to fit the cylinder in which the stem moves. In constructing cocks of this description, the patentees also cast the cylinder, with its inlet passage and valve seat, in a metal mould and on a truly turned core, and thus the cylinder and valve seat are cast smooth and true, and require neither boring nor turning, which heretofore has always been required.

In Plate VII., fig. 1 shows a transverse section of a metal mould suitable for casting a plug for a cock of an ordinary form, the body of which may be of cast iron and galvanized, taking care that the hollow part of the body where the plug is received is made smooth and true. The lower part of the mould is made solid, whilst the upper part is formed in two parts; but the form of the mould and the number of parts of which it is composed may be varied, and the form of handle applied to the plug of the cock or tap may be varied. The lower part of the mould is usually made with handles which are screwed thereto at *a*, *a*, and such is the case in respect to the upper parts of the mould. The handle *b*, and the screw *c*, are of cast iron or of other metal, and they are placed in the metal mould before running in the melted metal. The smooth metal plug or core *d*, is also inserted into the mould before running in the melted metal, and is driven out therefrom immediately the casting is formed, but before the same is cold. *e*, is the "gate" or passage for running in the melted metal.

In manufacturing equilibrium taps or cocks according to this invention, the bodies or shells are cast in metal moulds in the following manner:—Fig. 2 shows a plan, and fig. 3 a section, of a metal mould in which the ways and valve seats are produced correctly by the act of casting the bodies or shells of such cocks or taps in soft metal. *a*, *a*, is the frame or stand of the mould, which in use is fixed on a suitable table or bench; *b*, *b*, are the two parts of the mould or matrix; *c*, is the metal core for forming the interior of the body and the valve seat. This core is capable of being drawn back by a screw *d*, when the casting has been produced. *e*, is the metal core for forming the interior of the branch inlet junction; this core *e*, is arranged to be drawn back by the screw *f*, when a casting has been formed in the mould. *g*, is the core which produces the division or split in the end of the body of the cock or tap, in which division or split the lever works in the ordinary manner; *h*, is the pouring passage or "gate."

The mixture or alloy of metals used both in producing plugs of cocks or taps, as described in respect to fig. 1, as well as in producing the bodies or shells of equilibrium ball valves or cocks, may be varied, but the following mixture is preferred:—75 parts of zinc, 18 parts of tin, 4½ parts of lead, 2½ parts of antimony.

The patentees claim, "First,—the mode of casting the plugs of

cocks or taps of soft metal, as described. And, Second,—the mode described for casting the bodies or shells of equilibrium ball valves or cocks, as described."

To EDOUARD MORIDE, *of Nantes, France, for improvements in the treatment of sea wrack grass for the extraction of the carbon and the salts contained therein.*—[Dated 13th October, 1864.]

FROM time immemorial, on the borders of the ocean, soda has been made from dried seaweed or wrack grass, burnt at a high temperature in pits in the open air. In this operation the alkaline salts are partly reduced to sulphurets by the carbon, a large portion of the alkali passing to the state of silicates, and the chlorides of magnesium are decomposed; at the same time chlorine, bromine, and iodine are volatilized.

It has often been attempted to extract the soluble salts contained in seaweed by maceration, but the conveyance of the material to the works often proves a matter of great difficulty, and its accumulation becomes embarrassing; moreover, the product of maceration is not readily bleached, and the liquors obtained are evaporated only at great cost. Recent experiments have been made in England to distil seaweed in closed vessels and gas retorts, the results of which were pyrogenated oils and carbonaceous residues from which salts are extracted. Here, again, such a manipulation requires a large plant and considerable labour. Now this invention consists in simply torrefying, or rather converting into charcoal, on the spot, the seaweed, either dried or not, and then lixiviating the charcoal thus obtained. To attain the carbonization of the seaweed, it is placed in conical frames, similar to those used by charcoal burners; or preferably, an apparatus is used as shown in vertical section at fig. 1, in Plate VIII., which consists of a number of iron bars *i*, *i*, attached to heads *a*, in such a manner as to constitute a truncated cone with a large base, the bars being connected to each other by strong clamping chains *v*, provided with hooks; a fire-grate *b*, is also disposed upon cast or sheet-iron plates, within the apparatus.

After choosing on the sea shore a spot where seaweeds are abundant, the sides of the apparatus are covered with wet seaweed or grass, for the purpose of excluding external air, the top *a*, which forms the chimney, being left open. On the grate *b*, is placed the dried seaweed, which is ignited little by little: the flame extends and ascends, drying the wet seaweed, which becomes carbonized and drops beneath the grate. By means of a rake the charcoal is drawn out by the door *o*, and when it no longer smokes it is either extinguished in a closed or other vessel or by watering it slightly.

During the whole time that the operation is going on care should be taken to keep down, by means of fresh layers of wet material, the fire, which would otherwise manifest itself on the outside of the apparatus. Care also should be taken at the same time to prevent any ashes or agglomeration of soda forming during the carbonization, as in that case the most part of the salts would become decomposed, as above specified, and this would not differ from the ordinary process, which is to be avoided. The charcoal or product obtained, which represents from

five to six per cent. of the fresh seaweed incinerated, is then carried to the works, to be there treated; it is afterwards put in baskets lined with cloth, and placed in vessels filled with water, where the salts are dissolved, and on account of their density fall to the bottom of the vessels. They are then cleared out and evaporated in iron boilers, as practised in salt refineries, where the salts are collected as they settle, drained, and ranged by categories, according as they are crystallized at such or such temperature. The mother waters, in which iodine is concentrated, are treated by the usual methods, viz., by sulphuric acid, chlorine, the salts of copper, and sulphurous acid; or preferably, by the two following processes:—

First Process.—The mother waters are first acidified by means of sulphuric, acetic, or nitric acid; a sufficient quantity of hypoazotic acid is then added, for setting the iodine free, and that body is dissolved by means of benzine. To this liquid a weak solution of caustic potash is added, and then the benzine is agitated, decanted, and the alkaline liquid evaporated, in which is comprised the equivalent of the whole iodide of potassium which was contained in the plant. The residue is then calcined and purified.

Second Process.—The mother waters are concentrated to dryness, and the residues thereof are treated by boiling alcohol; the solution is then bleached by animal charcoal, which is distilled, in order to collect the alcohol used; and, lastly, the iodide of potassium settled at the bottom of the still is purified by the known processes.

In order to produce directly carbonates of soda and potash, or soda and caustic potash, with the product of the torrefaction, a mixture of sulphuric acid, seaweed, charcoal, and lime is made, according to Leblanc's method; the whole is then calcined in a furnace, lixiviated, and evaporated by the usual methods.

Fig. 2 is a plan of fig. 1, showing the carbonaceous incinerating apparatus for treating seaweed containing soda and iodine; fig. 3 shows, in detail, the central cross section of the grate *b*; fig. 4 shows the central longitudinal section of the same; and, lastly, fig. 5 is a plan of the same. The three last figures are drawn on a larger scale. *i*, *i*, are rounded or flat iron bars; *a*, the cap; *v*, *v*, clamp chains, or mere hooks on the iron uprights *i*; *b*, the grate; *c*, *c*, sheet or cast-iron, stone, or brick plates; *o*, the door of the furnace; *g*, surrounding seaweed; *m*, iron or cast-iron grate, with moveable bars, either round or square, carried on two cast-iron bars *r*, formed with grooves to receive them; *n*, thick fire-clay tiles or flat stones, or, it may be, a sheet or cast-iron box for forming the sides of the apparatus; *w*, *w*, the sole of the apparatus supporting the side tiles, and intended to receive the charcoal and prevent any intrusion of sand; *z*, section of the tiles or bricks bedded in the ground.

The following are the claims: "First,—burning, incinerating, and reducing seaweed into charcoal on the spot, and at a low temperature, by means of the apparatus described or otherwise, whilst heretofore, to obtain the same products, it has been usual to incinerate the same, completely burning the very charcoal which I form in my operations, and treating only incinerated material, in order to obtain the before-mentioned products; and I claim also my improved process for burning seaweed on the spot, either in the wet or dry state, even on their issuing from the sea, in any season, in winter as well as in summer.

Secondly,—treating the charcoal by cold or hot water, in order to extract the salts contained therein, as described. Thirdly,—applying the carbonaceous residues of seaweed, and the same with the addition of terreous phosphates and animal matters, to agricultural purposes, to painting, to disinfecting putrid substances; in short, to all purposes where it may be desirable to use very fine porous and black charcoal. Fourthly,—extracting iodine and the salts contained in the mother waters by means of benzine, alcohol, aniline, sulphuret of carbon, and other liquid carbonated hydrogens. Fifthly,—manufacturing caustic soda and potash, and their carbonates, with seaweed charcoal, by Leblanc's method, all which processes have never before been employed by any manufacturers of the same products."

To JOHN THOMAS COOK, *of Leicester, for improvements in the construction of battens for weaving.*—[Dated 13th October, 1864.]

THIS invention consists in adapting to the shuttle races of looms employed for plain and figure weaving, and for the manufacture of elastic web, certain novel and improved mechanism for driving the shuttle.

In Plate VII., fig. 1 represents an elevation of the back of the batten and shuttle race of a loom suitable for weaving narrow goods, such as elastic web, showing the improvements adapted thereto. Fig. 2 is a plan view of the shuttle and batten, and portions of the shuttle race, showing the method of connecting the shuttle with the improved mechanism for throwing the shuttle across the loom and through the shed of the work. Figs. 3 and 4 respectively exhibit transverse and vertical sections taken through the line A, B, and C, D, of fig. 1.

A, A, are boards forming, by the spaces at *a*, *a*, the shuttle race of the loom; B, B, are brackets for holding the boards A, in proper position; C, is that part of the batten which beats up the work at each shed of the warps: the upper part of C, takes into a slot formed in the tube D, and the lower part rests in a recess formed in the piece E, to which piece the brackets B, are securely fixed: G, is a long spindle supported by and working in bearings formed in the brackets B; H, H^1, are cylinders having helical grooves or quick-threaded screws *, *, formed around them; these cylinders have a hole formed through the centre of each, in the direction of their length, so that when said cylinders are passed on the spindle G, and tightened thereon, by the screws *c*, *c*, the aforesaid spindle and cylinders will revolve together upon rotatory motion being imparted thereto, either by an endless strap or band passed over the pulley I, or by other convenient and suitable means; K, is the shuttle carrying the cop containing the weft in the usual way. For the purposes of this invention studs or pins *d*, *e*, are fixed into the back of the shuttle near each end thereof, and take into the grooved helices formed around the cylinders H, H^1; care being taken to so arrange them with respect to the helical grooves in the cylinders H, H^1, that when the shuttle is thrown across the loom and through the shed of the work, in the act of weaving, one of the pins shall not leave its respective grooved cylinder until the other pin has entered into the helical groove of the other cylinder. In order to obtain great velocity of the shuttle, the grooved helices should be made of such a pitch that one revolution of the loom shall produce two revo-

lutions of the cylinders H, H[1], during which time the shuttle will be thrown twice across the loom.

The patentee claims "the general combination and arrangement of the parts above described, and especially the helical grooved cylinders H, H[1], and studs or pins *d*, *e*, as constituting improvements in battens for weaving."

To John Henry Dallmeyer, *of Bloomsbury-street, for improvements in the construction of lenses, which improvements are especially applicable to lenses for photographic purposes.*—[Dated 14th October, 1864.]

This improved lens is chiefly intended for landscape photography, and from the nature of its construction embraces a larger angle of view, with more perfect correction of both the spherical and chromatic aberrations of the oblique or excentrical pencils, than the forms of lenses hitherto used for that purpose.

The lens is composed of three lenses cemented together, two of which are made of crown or plate glass, and between the two is positioned a flint glass lens. Thus both external lenses are made of crown or plate glass, and both external surfaces belong to the crown or plate glass lenses, whereas, in the existing forms of view lenses referred to, consisting of two lenses, only one of crown and the other of flint, one surface of the crown and one of the flint is necessarily exposed, and this latter surface is liable to be affected by atmospheric influences.

The figure in Plate VIII. shows the improved construction of photographic lenses in cross section. *a*, is the anterior, and *b*, the posterior lens; they are of crown or plate glass, and by preference of different qualities, in order that, as is well understood by opticians, a more perfect chromatic correction may be obtained. The relation between the radii of curvature of the concave surface of the lens *a*, and of the convex surface of the lens *b*, should be as 2, 1, or thereabout, and also their focal lengths should be in the relation of 1, 3, or thereabout. *c*, is the flint glass lens interposed between the lenses *a*, and *b*, to form a compound lens which is achromatic or nearly so; its curvatures should correspond with those of the adjacent faces of the lenses *a*, and *b*, so that the three portions of the compound lens may be cemented together to form a solid whole. There are, however, some special cases in which it is desirable not to cement the lens *a*, to the other portions of the compound lens, viz., in lenses employed specially for photographing architectural objects, for it will be found that the straightness of the lines will be better maintained if the lens *a*, is placed at a distance from the other parts of the compound lens if the distance between the lenses *a*, and *c*, which corresponds with the best performance in this respect, is easily found in each case by experiment, or it may be ascertained by calculation. The diaphragm, or stop, is usually placed at a distance of about one-twelfth of the focal length of the lens in front of the lens *a*.

The patentee remarks that it is not new to make compound lenses in three parts with a centre negative lens of flint glass covered on both sides with positive lenses of crown or plate glass. Although such lenses are not usually employed for photographic purposes, they are

common in telescopes and microscopes; in such compound lenses, however, the flint glass lens *c*, has never been made convex on either face, whereas it is important that this lens should be convex on one face. Heretofore also, in compound lenses consisting of three parts, the anterior surface of the anterior lens *a*, has never been made concave, whereas it is important (although not absolutely indispensable) that it should be so made.

By these improvements a more perfect correction than heretofore of both the spherical and chromatic aberrations of the oblique or excentric pencils is obtained, whilst at the same time the flint glass lens is protected from injury by the crown or plate glass lenses on either side of it.

To JOSEPH MAURICE, *of Langham-place, for improvements in the means or method of producing optical illusions in theatres or exhibitions.*—[Dated 17th October, 1864.]

THIS invention consists of certain arrangements made on the stage of a theatre or exhibition room, by means of which optical illusions of a novel character are obtained. It has hitherto been the practice, in producing spectral illusions, to place the real actor or object out of sight, and to throw a representation or image of such living actor or real object upon a sheet of glass placed on the stage. But by this invention the actor may perform in the ordinary manner on the stage, and be at pleasure obscured or concealed, without apparently interfering with the objects which surround him. In order to accomplish this end, the inventor reflects on or in an unsilvered plate of glass, vertically or otherwise arranged, a picture, which is, as nearly as possible, a counterpart or duplicate of that portion of the scene which is obscured by the actor on the stage; and he so places the actor in the line of the shadow cast beyond and around him, that the whole of his person will be rendered invisible by the reflection on or in the glass of the duplicate scene, which may be wall, forest, wainscoting, article of furniture, or other stage representation.

In using a vertical arrangement of one or more plates of glass as reflectors, placed at a suitable angle in regard to the front of the stage, this result is effected by the arrangement of a false scene or portion of scene placed at the side or sides of the stage, and screened as far as possible from the view of the audience; then, on the false or duplicate scene being illuminated by the lime, electric, or other strong light, together with the stage or portion of stage in the front thereof, and in front of the glass, the scene and floor will appear on or in the transparent mirror, as a portion of the scene and stage behind the glass. When it is not intended to obscure the real figure of an actor in his passage across the stage behind the glass, the stage or scene lights are permitted to predominate, or the light on the duplicate scene and stage is turned down, or other means used, so that no scene or representation is reflected in the glass; but when it is desired that a real actor shall vanish, the scene lights directed towards that portion of the stage are rendered less powerful, and the duplicate or false scene and stage are illuminated, so that their reflection occupies the glass when the actor passes between the glass and the scene beyond,

and his figure is completely hidden, by reason of the representation on or in the glass which conceals his person from view. The patentee also obscures or shuts off the living actor or inanimate object behind the glass, by the reflection of a duplicate scene and living actor or actors or object; thus changing by reflection the figure of the actor or object behind the glass to the representation of the figure or figures or object reflected on the glass; the figure or figures behind the glass may then retire unobserved, and others may take their places; the lights may then be reversed, so as to show the actors behind the glass; the figures previously reflected may then be changed, and in turn again reflected, and so on, thus causing a succession of changes in the representations.

An actor or object is caused to appear suspended, walking, or flying in the air, or dancing on a tight rope, by eclipsing or obscuring by the aforesaid means a raised platform or support on which they may be placed, the actor or object being thus above the shadow; or certain portions only of such real person or object may appear, by cutting off portions of the duplicate scene, or by illuminating portions of such figures or objects.

If it be desired to cause the disappearance of an actor seated on a chair, or reclining on a couch, without causing the chair or couch to vanish, before throwing the reflecting light on to the duplicate scene a perfectly similar chair or couch is placed in front of it.

In working the invention, the employment of large glasses is not imperative, as a glass of area sufficient to shut out the object which is to disappear is all that is absolutely necessary.

The patentee claims, "the optical illusion of causing real and animate or inanimate bodies to disappear from view, although remaining on the same spot, by covering them with the reflection of a scene similar to, or differing from, that which is on the stage, when effected substantially as described."

To JAMES GRAFTON JONES, *of Blaina Iron Works, Monmouthshire, for improvements in machinery employed in getting coals, stone, and other minerals.*—[Dated 21st October, 1864.]

IN working picks for cutting coals mounted on carriages on railways or trams when actuated by power, it is found, particularly when performing that part of the work known as "holeing" or undercutting, that there is a tendency for the carriage and machinery to swerve and vibrate on the rails to the prejudice of the way. Now, this invention consists in the application of a rolling weight or roller to the hinder part of the carriage. This roller or weight runs on the rails, and is formed with flanges, to keep it correctly on the rails. The roller or rolling weight is connected with the under part of the carriage by a bar in a central position between the rails of the way in which the carriage runs. This bar is made in two parts, in order that its length, and the distance of the roller from the front of the carriage, may be adjusted. The fore end of this bar is securely and rigidly fixed by screw bolts and nuts to the under part of the carriage. The axis of the roller turns in a single bearing, which is equidistant from the two ends of the roller.

The figure in Plate VII. is a side elevation, partly in section, of the apparatus applied to a carriage employed in getting coals or minerals. *a*, is a bar, which is formed in two parts, which are connected by screw bolts and nuts; and as one of the parts is slotted, the length of the bar between the carriage to which its fore end is fixed, and the roller *b*, at the hinder end may be adjusted. *c*, is the hinder part of a carriage, such as is now used to carry picks or cutting instruments for getting coal or mineral. The bar at its fore end is fixed rigidly to the hinder part of the carriage by screw bolts and nuts, but such means of fixing may be varied. On the bar is fixed a platform *d*, for the workman, or for other uses.

The patentee claims, "the application of apparatus such as is herein described to a carriage arranged for carrying picks or cutting instruments used in getting coals and minerals."

To GEORGE ASHCROFT, *of Hendon, Sunderland, for improvements in the construction of hydraulic presses employed for pressing cotton and other fibrous substances, fuel, hay, peat, and other vegetable matters and substances, and for crushing mineral substances.*—[Dated 2nd November, 1864.]

THIS invention consists in a mode of combining the action of steam and hydraulic power to presses, whereby the steam power is caused to perform the first part of the pressure when making a stroke in one direction, whilst in the return stroke motion is communicated from the steam power to the plunger of a force pump, or the plungers of force pumps, so as to cause water or other fluid to be forced into the hydraulic cylinder of the press, and thus give motion to the hydraulic ram, in order to complete the requisite pressure. The arrangement and details of construction of the parts of the presses may be greatly varied, but such variation will, however, depend more or less on the purpose to which the invention is to be applied; but a machinist will readily make such variations, when aided by the following description of the arrangement and combination of a press suitable for pressing cotton:—The press is constructed for the most part similar to an ordinary hydraulic press. Between the top and bottom of the press is an ordinary box or trunk, with openings and doors at the upper part for removing the bale when formed and lashed or bound. Through these openings the trunk or box is charged with cotton in the ordinary manner, at the time the follower of the press is at its lowest position. Steam power is applied to this press in the following manner:—At the top of the press, and combined therewith, a steam cylinder is fixed, and also a force pump. The piston rod of the steam cylinder is connected to a cross head, so as to give motion thereto; and the length of stroke of the piston is to be equal to the greatest length of motion it is desired to give to the follower of the press by steam power. It is preferred that provision should be made by adjustable tappets or studs, as is well understood, in order that the stroke of the piston in the steam cylinder may be stopped and reversed at any points short of the whole length of stroke of such piston, and that the extent of movement of the follower of

the press, when actuated by steam power, may be adjusted to any length within the full range or length of the stroke of the piston of the steam cylinder.

A very convenient arrangement for a cotton press, according to this invention, is to have a single steam cylinder fixed at the top of an otherwise ordinary hydraulic press, together with two force pumps, one on each side of the steam cylinder. The plungers of the force pumps have a like length of stroke to that of the piston in the steam cylinder, the plunger rods of the pumps being connected to the cross head fixed at the top of the piston rod of the steam cylinder. The two force pumps, by means of suitable pipes and valves, communicate respectively with a cistern and the hydraulic cylinder, so that in the up stroke of the piston in the steam cylinder, water will pass into the cylinders of the force pumps, whilst in the down stroke of the steam piston the water will be forced from the force pump cylinders into the hydraulic cylinder and actuate the ram therein, and cause it to continue and finish the pressure commenced in the following manner, by the up stroke of the piston in the steam cylinder, by the aid of two side rods, connected one at each end to the cross head, before mentioned, which is put in motion by the steam power. The other or lower ends of such two side rods are connected to the two ends of a bar or beam, through the centre of which the ram of the hydraulic cylinder can move freely; this bar or beam comes under the follower of the press, so that in the up stroke of the piston in the steam cylinder the follower and the hydraulic ram will be lifted, and the follower will, by the power of steam, press the cotton upwards within the trunk or box of the press. And in order that the bar or beam lifted by the side rods may be at liberty to ascend, there is a narrow opening on each side of the trunk or box to admit of the rise of the bar or beam. The rising of the follower, and consequently of the hydraulic ram to which it is fixed, will continue by the power of steam, till by the action of one of the tappets or studs on the valve the steam engine is reversed, when the hydraulic ram will be actuated by water being forced into its cylinder by the force pumps, by the descending stroke of the piston in the steam cylinder. The hydraulic cylinder is to be provided with an outlet for the escape of the water, when the bale has been lashed or bound, as is ordinarily the case, and water is to be allowed to flow into the hydraulic cylinder at the same time that water is flowing into the force pump cylinders, in order that the hydraulic cylinder may become full of fluid, as the hydraulic ram is raised with the follower of the press by the up stroke of the piston in the steam cylinder. In place of using only one steam cylinder at the top of a press, two or even more may be similarly used to give motion to the follower of the press in the up stroke, and to the plungers or pistons of force pumps in the down stroke.

When applying the invention to presses for other purposes than for compressing cotton and other fibrous materials into bales, the arrangements of the presses between the followers and the tops of the presses will be according to the particular purpose to which the press is to be applied; but the arrangement and combination of steam power to act with hydraulic power will be the same as that above described, and the followers of such presses will in all cases, at the commencement of the

pressure, be actuated by the power of the steam acting on the pistons in the steam cylinders, and so as to perform the first or more speedy part of the pressure, whilst in the return stroke of the pistons of the steam cylinders the force pumps will be put into action, and the remainder or slower and more powerful pressure will be completed by the follower of the press being acted on by the hydraulic rams.

To FELIX LIEVIN BAUWENS, *of Walworth, for improvements in cooking food.*—[Dated 4th November, 1864.]

THIS invention consists in the use of steam at any degree above 212° Fahr., conjointly with an oven or other apparatus heated by fire, or separately by the exclusive use of superheated steam, without an oven or other apparatus heated by fire, for the purpose of cooking food, such as meat, vegetables, and fruits. When using an oven or other apparatus heated by fire, a small jet of steam is admitted into the oven or apparatus through a pipe perforated with holes. When using superheated steam alone, a small jet of steam is let into a closet enclosed in a non-conducting caloric chamber. In both cases a pipe is fitted for the steam to escape from the oven, or apparatus, or closet. The temperature of the oven is ascertained by a thermometer passed inside with the indication outside. The effect of the use of steam is to regulate the temperature at which the food ought to be cooked, so as to allow it to retain its best flavouring quality without losing any portion, and without affecting the shape. On one hand it will secure the proper heat for the perfect cooking of meat or vegetables, and on the other hand it will prevent the overcooking and burning of meat and vegetables.

The use of steam is effectual in preventing the drying of the meat, as occurs in ovens; and experience has proved that joints which generally lose from 20 to 40 per cent. in the ordinary way of roasting or baking, do not lose more than 5 to 10 per cent. by this process, and at the same time the process produces a more juicy and succulent meat. As for potatoes, the effect is more remarkable, as it cooks and brings them all floury without crumbling or losing their shape; it keeps them entire, with a dry outward appearance similar to a roasted potato, without the hard browny crust.

The patentee claims, "First,—the introduction of steam at any degree suitable to effect the before-named results into ovens or other apparatus, in the manner described. Second,—the employment of superheated steam, to effect the results before-named, by its introduction into closets, in manner before described. And, Third,—the means of ascertaining the exact temperature in the ovens, apparatus, or closets, by the employment of a thermometer, as before described, so as to be able to regulate the temperature by a greater or less quantity of steam, or greater or less heat from the fire.

Scientific Notices.

MECHANICAL ENGINEERS' SOCIETY.

November 3rd, 1864.

(*Continued from page* 173.)

[It may appear ungracious to find fault with a Society so efficiently conducted as the Mechanical Engineers' Society of Birmingham, but we think it is hardly fair to the contributors of papers to delay (as has lately been the case) the publication of those papers for nearly twelve months after their discussion. There can be no necessity for such delay; and if it occurs through the inattention of members who have taken part in the discussion, they would be properly served by the issue of unrevised abstracts of their remarks.]

The first paper read was, "*Description of a coal-cutting machine,*" by Mr. Thomas Levick, of Blaina Iron Works.

The substitution of machinery for manual labour in our various manufactures and industries, the gradual development of railways, and the application of steam to navigation, have increased in a wonderful manner the demand for coal, that being the chief agent in the production of the motive power in all these cases. In the early periods of the working of the coalfields the produce of coal was very limited, the only means of conveying it from the pit to the shipping port being on pack horses carrying only 3 cwts. each, which were succeeded by the cart, increasing the load to 17 cwts. But by the introduction of railways the annual produce and consumption of coal in Great Britain was raised in 1855 to 64 millions of tons, in 1859 to 70 millions, and in 1860 to 80 millions; and, according to Mr. Hunt's returns, it has now reached the enormous quantity of nearly 90 millions of tons per annum.

Although coal has thus been so useful in promoting and extending the use of machinery, machinery has not yet returned the compliment by its application to the working of coal. It has made various futile attempts, and only within the last year or two have any really practical attempts been made to lessen or supersede manual labour in working coal: the working or getting may, in fact, be considered to remain still in the same condition as in the pack-horse age. Machinery has certainly aided the increased production of coal by winding and pumping engines, and by inclines above and below ground; but this kind of machinery has only facilitated the movement of the coal after it has been wrought by the collier. The actual working or getting it from the position in which it has been deposited in the mine ages ago is still accomplished only by tools of the most primitive kind, plied by the strong arm of the sturdy collier under the most disadvantageous circumstances; for he has to wield the pick in a stooping or lying position, most unfavourable to the application of his muscular

force, and this frequently in an atmosphere not only not remarkable for its purity, but sometimes of a temperature as high as 80° to 90° Fahr.

The constant but gradual increase of temperature in penetrating the earth's crust, which takes place at the rate of about 1° Fahr. to each 60 feet of depth, is well known. In the Monkwearmouth Colliery, the depth of which is 1800 feet, the temperature is 80°; and this is considered to be as high as is consistent with the great bodily exertion necessary in the operation of coal mining. There is also an additional augmentation in the temperature of deep mines consequent on the increased density of the air, and this is about 1° for every 300 feet of depth. Certain portions of the coal in the deeper coal basins lie at depths approaching, and even exceeding, 4000 feet; and the temperature of the air at this depth, according to the foregoing data, would be 79° higher than at the surface, 66° being due to the depth, and 13° to increased density of the air. The computations, therefore, of the duration of the coalfields, as has been pointed out by Sir William Armstrong, require a considerable reduction in consequence of the impracticable depths at which portions of them are situated; and any means of increasing the practicability of working at these depths by the application of machinery becomes consequently a question of serious importance in reference to the duration of the coalfields, in addition to the advantages in economy of cost and time of working, and in saving waste of material, that are incident to the substitution of machinery for hand labour.

Many attempts have been made during a century past to construct coal-cutting machines. One of the earliest was that of Michael Menzies, in 1761, consisting of a pick fixed on the axle of a pulley placed near the face of the coal, to which a reciprocating motion was given by means of a chain passing round the pulley, and connected with a steam-engine at the surface, the pick performing the operation of kirving or holing. He also invented a pick machine, to be worked by hand.

In 1830 a battering ram for coal mines was proposed by William Wood. This was a heavy ram fixed in a sliding box acting on a wedge, the ram being worked backwards and forwards by manual labour.

The next to be noticed is a plan in 1843, consisting in applying rotary saws or picks driven by a winch or an engine, for the purpose of severing blocks of coal from the surrounding mass. This was one of the first attempts for using rotary cutters, and the arrangements were complicated.

In 1846 a plan was proposed by Mr. W. H. Bell for suspending a heavy pick or chisel by a chain from a bar running along the face of the work at the roof, so as to be swung by hand against the coal.

In 1852 a machine was applied by Mr. W. D. Hedley, similar in its action to a planing machine, having a cutting tool projecting from the side of a carriage running on a railway, and the tool was made to cut deeper and deeper into the face of the coal by repeatedly traversing the carriage, and setting the tool at each successive cut to project more and more beyond the side of the carriage. There were holes in the machine at different heights, for altering the tool according to the different heights at which the coal has to be cut.

About the same time a plan was proposed by Mr. C. H. Waring, in which reciprocating or revolving cutters are worked by compressed air or steam. The reciprocating cutters have somewhat the motion of planing or slotting machines, but the rotary cutters are fixed in the circumference of a wheel, and act like a circular saw. The machine is arranged to cut either vertically or horizontally. The apparatus for applying the power is mounted on the frame of the machine, and consists of an oscillating cylinder, worked by compressed air or steam.

In 1861 a pick machine, to be worked by hand, was proposed by Messrs. Ridley and Rothery, the pick working horizontally and vertically, and both motions being upon fixed axes; and about the same time a hand machine was proposed by Mr. Donisthorpe, in which the tool was a bar mounted on grooved rollers, giving it a rapid motion forwards and backwards.

The above are some of the principal attempts up to that time to work coal by machinery. They may be divided into reciprocating picks, sliding or planing picks, and rotary saws or cutters; none of them, however, have continued in practical use. The principal practical difficulty in the application of machinery to coal cutting, is the confined space it is required to work in. Most of the machines above referred to occupy too much space, and are generally too complicated for application in a coal mine; and machines made to be worked by hand, on account of the friction of the mechanism and the cumbrous arrangement, absorb too much manual labour to give them much or any advantage over the pick worked by the skilled collier.

Not until the last two or three years has anything practically useful been accomplished in the application of machinery to coal cutting; and Messrs. Donisthorpe, Firth, and Ridley's machine, working at the West Ardsley Colliery, near Leeds, was the first machine which may be safely said to have demonstrated the practicability of cutting coal by machinery. This was one of the class of machines, working with a pick, which was driven by a cylinder worked by compressed air; and it was followed by another machine, which introduced a trunk arrangement of the driving cylinder, so as to shorten up the connecting rod, thereby considerably shortening the machine, and enabling it readily to traverse the quick curves of mine tramroads, thus removing a serious practical difficulty previously experienced. Both these machines have been successful in performing one operation in coal cutting, namely, "holing," or undercutting a seam of coal horizontally, and on a true plane, or nearly so. But as they were constructed only to cut a groove horizontally, or rather parallel to the plane of the tramway, they were not adapted to meet the cases of inclined seams, so frequently occurring in practice; and as they were also limited to the horizontal undercutting, all vertical cutting that was required in the operation of getting the coal had to be done by hand work. These machines were inapplicable to driving headings; and for that purpose a modification of them has been made, having two pairs of vertical picks, one pair on each side of the machine, and each pair consisting of one pick working upwards vertically from the bottom, and the other working downwards vertically from the top, so as to make the two cuts meet one another. The undercutting, however, in driving the headings, was still required to be done by the hand of the collier.

In order that a machine may be generally applicable to coal cutting, it should be capable of cutting in any direction, so as to work the "dip," or the "rise," or cut the vertical cuts. To do this, and at the same time to retain a simple form of machine, since complex machinery would be very objectionable underground, presented great difficulties; but these have now been entirely overcome in the coal-cutting machine forming the subject of the present paper, which is the invention of Mr. James Grafton Jones, of Blaina. In this machine the axis of the pick is carried in a revolving headstock, by which it is capable of being turned into any desired position, by merely turning a handwheel at the end of the machine; the relative position of the pick and the air cylinder which works it remaining always the same. By this means the pick can be worked in any plane, either vertical, horizontal, or at any inclination; and it is thus enabled to cut the coal vertically in driving headings, and horizontally in holing, or in any inclined direction for working the dip or the rise when the seam of coal does not lie horizontally. Headings may thus be driven, or any of the ordinary operations in the getting of coal or other minerals may be performed by the machine.

The machine is illustrated in Plate IX., Vol. XIX. of this Journal, and an improvement upon it is described at page 219 *ante*.

The air cylinder is placed horizontally, and is cast in one piece with the bed of the machine; and the piston is forged solid upon the piston rod. The lever pick is keyed upon a transverse axle carried in front of the cylinder; and on the axle is a crank arm to which the piston rod is connected by means of a pin which enters the slotted head of the piston rod. The transverse axle is carried in bearings cast upon a rotating headstock; and this headstock is capable of being turned round in its bearings by means of gearing actuated by a hand-wheel. The pick can thus be turned so as to cut the coal at any inclination whatever, the piston turning in the cylinder when the headstock is rotated; and when the pick is adjusted for working at any desired inclination, the transverse axle can be locked in that position by means of a pin passing through one of the holes in the hand-wheel.

The slide valve, by which the compressed air is admitted to the cylinder, is worked in one direction by the piston, which, on completing its back stroke, strikes against a tappet rod, working through a stuffing box in the back cover of the cylinder, and connected to a rock lever jointed to the slide valve stem. When the tappet rod is struck by the piston, it moves the valve into the position for admitting the compressed air to the back of the piston, for striking a blow by the pick. The valve is retained in this position until the blow has been struck by means of a spring catch, which is connected by a rod to a treadle. An india-rubber spring passes round the handle of the rock lever, attached by means of an adjustable joint to the platform, on which the man working the machine is carried. When the treadle is depressed by the man's foot, it releases the catch, and the india-rubber spring immediately moves the slide valve, so as to admit the compressed air to the front of the piston for making the back stroke; and another blow of the pick is then given by the piston striking against the tappet rod. As the work progresses, the machine is moved forwards by a hand-wheel,

which communicates motion by the bevil wheels to the carrying wheels of the machine.

From this description it will be seen that, at whatever inclination the coal may lie, the pick is easily put to work at that exact angle, whether to the rise or the dip. It may also be easily put to work at any part of the thickness of the coal, whether it be desired to hole at the bottom or at the top of the measure, or at a parting in the middle, or any other portion of the seam, by simply shifting the pick to a greater or less distance upon its axle.

The machine, when holing in the coal, cuts a groove 3 feet deep, 2 inches wide at the face, and 1½ inch at the back; whereas a collier requires for effecting the same purpose to make a groove, or rather excavation, 10 to 12 inches wide, or even more at the face, and tapering to the back. In doing this the collier is exposed to one of the most frequent and unavoidable dangers of the coal mine, by the large lump of coal breaking off and sliding down suddenly without warning, before he has completed his task.

The machine is calculated to work at the rate of 70 to 80 strokes per minute; and the one at work at the High Royd Colliery, Barnsley, under disadvantageous circumstances, and in the hardest coal in the district, holes from 9 to 10 yards length per hour, 3 to 3½ feet deep, including stoppages. In order to make the machine thoroughly effective it is necessary that it should be on a good rigid road; but at this colliery it is working on the ordinary tramplate road loosely laid. The pressure of air at which it is worked is 30 to 35 lbs. per square inch. In the same seam of coal the collier does only 4 to 5 yards length of holing for a day's work, in place of the 90 to 100 yards done in 10 hours by the machine, the latter thus accomplishing fully twenty times the work that the collier can do by hand in the same time.

A second machine has just been put to work at the Oaks Colliery, in the same district, in which an improvement has been made by the addition of a steadying apparatus, consisting of a tail piece which carries a pair of heavy rollers. These rollers rest upon the tram rails and keep the machine steady under the vibration caused by the blows of the pick when striking laterally in holing. This tail piece follows with the machine when moving in a straight line; and it has the effect of lengthening the wheel base of the machine, and considerably reduces the lateral vibration on the road caused by the powerful blow of the pick when holing. It is readily detached when required to go round the short bends of the mine; and also when driving headings it is not required, as the pick is then working vertically. The machine at the Oaks Colliery holes at the rate of 14 to 15 yards length per hour, to a depth of 3½ feet, the number of strokes averaging from 60 to 70 per minute, and the pressure of air being 35 to 37 lbs. per square inch. The road in this case is a railroad thoroughly well laid.

These machines are also well adapted to work in the ironstone shales and to quarry Bath stone; indeed, the pick would work in anything softer than its own point.

The use of compressed air for working underground machinery is not new, though it is only recently and since the introduction of coal-cutting machinery that it is being more extensively employed. The first practical employment of it in this country was at the Govan

Colliery, near Glasgow, in 1849. The machinery was erected by Messrs. Randolph Elder & Co., and a description of it was read before this Institution at the Glasgow Meeting, in 1856. At the Haigh Colliery, near Wigan, two air-compressing engines were also employed, the air being compressed to 120 lbs. per square inch, and carried down a shaft 234 yards deep, and to a distance of 500 yards from the bottom of the shaft. The engines worked by the compressed air at this colliery, and at the Govan Colliery were employed for winding underground.

A peculiarity attendant upon compressing the air is the heat developed during compression, which increases rapidly with the pressure. Thus air, which at the atmospheric pressure of 15 lbs. is at 32° Fahr., would be raised to 110° by being compressed to 30 lbs. per square inch; and at 120 lbs. per square inch, the effective pressure in the Haigh engines, the theoretical temperature would be about 450°. A special provision to meet this circumstance is mentioned hereafter. An inconvenience in working these compressed-air engines was the liability of the air passages and exhaust pipes to become clogged with ice, in consequence of the water suspended as moisture in the air being frozen by the cold produced in the sudden expansion of the exhaust air. This is avoided in the coal-cutting machines, by making the slide valve with sufficient inside lap to cause the exhaust air to escape slowly at each stroke, thereby preventing its sudden expansion; and this arrangement, combined with the concussion caused by the stroke of the pick, prevents the exhaust passages becoming clogged with ice. In an air engine at Dowlais, when the air was escaping under a pressure of 15 lbs., the temperature of the exhaust air was 29° Fahr.; and the greater the pressure, the greater will be the cold produced in expansion.

There is a loss of power in air-compressing engines, arising from leakage and friction in the air pipes, and the mechanical power lost in the form of heat when the air is compressed. The loss from leakage and friction is very small, and if the joints are good, that from leakage will be inappreciable; but the loss from the escape of heat is great. The cylinder in which the air is compressed gets so hot, that it is necessary to keep it surrounded with water, the temperature increasing with the pressure to which the air is compressed; and, on the other hand, when the compressed air has done its work, and is allowed to escape, a degree of cold is produced which freezes any moisture that there may be in the exhaust passages. By the compression of the air its capacity for heat becomes diminished; consequently, a portion of the latent heat already contained in it at its natural pressure is developed in the form of sensible heat, and this is absorbed by the cylinder and the surrounding water. The air itself does not get sensibly hotter, since only its capacity for heat is changed by the compression, while the excess of heat developed by its compression is rapidly absorbed by the surrounding metallic surfaces, which conduct it away. When this air has done its work, and expands again to its original pressure, its original capacity for heat returns; and the quantity of heat then contained in it not being sufficient for maintaining the same temperature in its expanded form, it consequently draws heat from the surrounding bodies, thus producing cold. The amount

of heat thus absorbed in the act of expansion is the exact equivalent of that which is developed during compression; but the heat developed in compression being lost by conduction, the amount of power equivalent to it is also lost.

The air-compressing engine, for working four to six coal-cutting machines, consists of two cylinders, one the steam cylinder and the other the air cylinder, fixed horizontally on the same bedplate, the piston rod of the steam cylinder being directly attached to the piston rod of the air cylinder. The steam cylinder is 16½ inches diameter and 3½ feet stroke. The air cylinder is surrounded by water, to keep it cool. The compressed air passes through delivery valves into the pipe leading to the mine. The inlet valves are fixed on the side of the air cylinder, and are similar to the delivery valves. The slide valve of the steam cylinder is worked by a tappet, as there is no crank or flywheel to the engine. The speed of the engine is regulated according to the number of the coal-cutting machines at work. When all six machines are at work, the speed of the piston is from 250 to 300 feet per minute.

The effect produced upon the ventilation and temperature of the mine by the supply of air from the discharge of the coal-cutting machine may now be considered. When the machine is working at 60 blows of the pick per minute, it will discharge 24 cubic feet of air per minute at a pressure of 45 lbs. per square inch, which by expansion becomes 72 cubic feet of air at the atmospheric pressure, and at a temperature below freezing point. Taking the quantity of air passing along each face of work in the mine at an average of 6000 cubic feet per minute, at a velocity of 4 feet per second, the quantity of air discharged by each machine would be only 1¼ per cent. of the whole amount. Supposing the temperature in the mine, as at Monkwear-mouth, to be about 80° Fahr., it would be reduced only 1° when thoroughly mixed, but it would be considerably cooler round the point of issue. The ordinary ventilating current has frequently had to travel considerable distances, and has acquired a great deal of impurity and a high temperature before it reaches some of the faces of work. But supposing three or four machines to be employed along each face, the current, instead of becoming impure, would retain its purity and become cooler.

A collier when at work breathes heavily, and inhales about 28 cubic feet of air per hour, and exhales about 1 cubic foot of carbonic acid in the same time. One coal-cutting machine may be said to save the work of twenty colliers, who would inhale 600 cubic feet of air per hour; while the machine supplies 4320 cubic feet per hour of cold and pure air, at the place where it is most required.

The firedamp in a mine having only half the specific gravity of air, is very apt to float above the passing current of air, instead of mixing with it, especially where there is any unevenness in the roof, forming cavities in which the firedamp can lie stagnant. The violent agitation, however, produced by the discharge of air from the coal-cutting machine will aid materially in the intermixture of the gas with the current of air, and the discharge of air from the machine may be directed to any particular point, as desired.

The advantages of cutting coal by this machine may be summed up as follows:—

1st. The saving of a large per-centage of small coal in the process of holing, and a corresponding increase in the proportion of large coal obtained.

2nd. The economy in the cost of getting the coal.

3rd. The improvement in the ventilation and temperature at the working points.

4th. The facility with which headings may be driven and ventilated, the machine itself supplying air sufficient for several men, and at a low temperature. The machines being well adapted for driving headings, collieries may be opened and won to their outside boundaries in a much shorter time.

5th. The saving of life and limb to the collier, by removing him from the most perilous portion of his occupation, that of holing or undercutting the seam of coal.

6th. The power of carrying the working into the deeper seams of coal, which lie at so high a temperature as to present serious difficulty in the way of performing the severe labour of cutting the coal by hand work.

Mr. F. Levick exhibited a model of the coal-cutting machine, illustrating the action of the pick in cutting the coal at any inclination, by means of the revolving axle carrying the tool.

The Chairman remarked that the application of machinery to coal cutting was a subject of great importance, and there could be no doubt that ultimately coal-cutting machines would greatly assist manual labour, by performing the most difficult and dangerous work of undercutting the coal. In the machine described in the paper just read, the principal feature appeared to be the arrangement by which the tool was turned round to work at any inclination, thus affording the means of cutting the coal at any angle. The machine was otherwise similar to that of Messrs. Donisthorpe Firth and Ridley, which was now working at the West Ardsley Colliery, near Leeds, and he believed that was the first instance in which machinery had been successfully brought into practical operation for coal cutting, by the use of compressed air actuating a pick. The machine was capable of being worked in any part of the mine by compressed air supplied to it from an engine at the surface.

Mr. W. Mathews had not had an opportunity of seeing coal cutting performed by machinery, but was satisfied that if the application of machinery to that purpose could be practically accomplished, it would prove a most important benefit in coal mining. The recent struggle with the colliers in South Staffordshire was a sufficient proof of the necessity of adopting machines for cutting coal in place of manual labour.

Mr. F. Levick, in answer to questions, explained that the machine excavated only 2 or 3 inches thickness of coal in undercutting the coal to a distance of 3 feet in; and the coal so undercut could then be benched down for a height of 2½ feet, if desired; after which the machine could go under, and proceed with the holing 3 feet further in, and so on to any extent of undergoing that might be desired, since the machine was made low enough to enter into any space 2½ feet high, and could thus go under the coal wherever a collier could work in the

ordinary system of holing. The great advantage, however, of the machine over the collier was that while the whole thickness of 2½ feet was converted into slack by the collier, in order to cut an excavation large enough to admit him to go under, the machine converted only 2 or 3 inches thickness into slack, and the remainder of the 2½ feet thickness was obtained in the form of good serviceable coal. The machine shown in the drawings was low enough to work in a height of only 2½ feet; but it could be made considerably lower by diminishing the size of the carrying wheels, and otherwise modifying the construction. In undercutting the coal, the axle of the pick was turned so as to bring the pick into its lowest position, enabling the pick to excavate the coal as low down as on a level with the rails.

The following paper was next read, "*On puddling iron by machinery,*" by Mr. Henry Bennett, of Wombridge Iron Works.

In the manufacture of wrought iron from the crude pig iron, the purifying of the metal by the process of puddling involves very heavy and long continuous hand labour; since the metal, after being melted in the puddling furnace, has to be continuously stirred for a considerable time whilst boiling, in order to expose it thoroughly to the action of the current of air passing through the furnace, so as to effect the chemical changes required for the separation and removal of the impurities originally combined with the iron. The metal has then to be balled up into separate masses of about ¾-cwt. each for the shingling hammer; and the whole process extends over about an hour, from the time of melting the pig iron for each heat, of which six are worked in the day.

The application of machinery to puddling has long been felt to be very desirable, on account of the laborious nature of the process, owing to the continuous heavy work required, and the great heat to which the men are exposed; and the simple mechanical character of the greater portion of the process, which consists in merely a continuous uniform stirring of the material, renders it very suitable in that respect for the application of machinery. But the high temperature of the furnace, and the necessity for not interfering with the current of air passing through it, which has to be regulated and changed as the process advances, cause great practical difficulties in successfully carrying out the application of machinery in place of hand labour.

Many attempts have been made to accomplish puddling by machinery. A rotary furnace has been tried, having the portion containing the melted iron made to revolve by machinery horizontally upon a vertical axis, with a scraper placed across it for stirring the metal as it revolved, the object being to effect the entire operation by machinery; but the practical difficulties in keeping such a machine at work, and obtaining the proper result in the process, were found too great to be surmounted. Various attempts have also been made to produce an action similar to that of the hand puddling process, by means of machinery more or less complicated. But it is important that any apparatus for the purpose should be simple in construction, and not liable to get out of order under the rough usage of the men by whom it has to be worked.

The object of the writer has been to employ machinery simply to aid the puddler by relieving him of the most laborious part of the work, namely, the stirring or working of the metal in the puddling furnace. At the same time the objects aimed at have been, by a more rapid and uninterrupted process of stirring the metal, to shorten the time of the puddling, thereby economising fuel; to improve the quality of the iron, by rendering the process more uniform and perfect than with hand labour; and to increase the yield of the furnace, by working larger charges than could be both puddled and balled up at one heat by hand labour alone.

The ordinary puddling tool or "rabble" is worked backwards and forwards in the puddling furnace by a vertical arm outside the furnace, to which it is connected by a notch in the handle of the rabble, dropped loosely upon a pin at the bottom of the working arm. This arm is cottered at top into a horizontal square bar overhead, sliding longitudinally through two guide sockets, and worked by connecting rods from a long T iron bar, extending horizontally across a whole row of puddling furnaces, the T bar being carried by antifriction rollers. A longitudinal reciprocating motion is given to the bar by a crank at one end driven by engine power. The guide frame or sector carrying the guide sockets of the sliding bar is centred on a vertical pin immediately over the door of the puddling furnace, and the outer end is moved transversely from side to side with a slow reciprocating traverse along a guiding quadrant, by means of a connecting rod from a crank, which is driven through a worm wheel and a screw shaft, extending over the furnaces alongside the reciprocating T bar. This bar works at a speed of about fifty strokes per minute, and has a length of stroke of 2 ft. 10 in., carrying the rabble with the same length of stroke across the floor of the furnace. The transverse motion given by the crank, which makes one revolution for every seventy strokes of the rabble, causes the direction of each stroke to change gradually between the two extremes of the guiding quadrant; so that the end of the tool, instead of moving backwards and forwards always in the same line, is worked successively over every portion of the floor of the furnace, within certain limits, in lines radiating from the working hole in the door of the furnace, corresponding exactly to the action in hand puddling. In the double furnace, with a door on each side, two traversing cranks are set at right angles to each other, so that the two rabbles are always working in different parts of the furnace. The whole of the machinery is kept clear above the furnace, outside, and completely protected from the heat, and quite out of the way of the men; nothing being exposed to the heat except the rabble or puddling tool, the same as in hand puddling.

The double furnace is exactly the same in construction in all respects as the ordinary single puddling furnaces, except that it is made with a working door at each side and is one foot wider inside.

When the charge of pig iron is melted and ready for the commencement of the process of puddling, the apparatus is put into action by simply dropping the notch in the handle of the rabble, on to the pin in the working arm, which is kept continuously in motion by the horizontal reciprocating T bar working overhead. The puddler changes his tool from time to time, as it becomes heated, by simply lifting the

notch in the handle off the pin in the working arm, and replacing the tool with a fresh one, without stopping the machine; and when the iron begins to thicken, he takes the opportunity of each change of tool to make a few strokes by hand, in order to collect the metal from the extreme sides of the furnace into the centre, which is found to ensure the whole charge being uniformly worked. The usual time of working with the machine is about 25 minutes with ordinary forge pig iron, the tool being changed five or six times; but with grey iron the time of working is much prolonged. In the latter case the machine is especially serviceable, since the iron keeps in a fluid state much longer, and requires consequently so much more working; which causes the labour to be so much more severe in the case of hand puddling, that there is great difficulty in getting the men to work any iron that is very grey. With the machine, however, this causes no increase of labour to the men, and only increases the time of the process.

When the iron begins to thicken, or, as it is termed, is "coming to nature," the machinery is disconnected without stopping it, by simply knocking out the cotter that fixes the upper end of the vertical working arm; the arm then drops out, leaving the furnace door entirely clear for the puddler to ball up the iron, which is done exactly in the same manner as in ordinary puddling furnaces, without the man being in any way inconvenienced by the machinery continuing at work overhead.

The general objects aimed at in this puddling machine have been simplicity of construction and action, and small cost both in construction and repair. The machine has nothing in it liable to get out of order, and possesses great durability in the working parts. Also, the object has been to improve the quality of the iron produced, by its being more thoroughly and uniformly worked than is done by hand labour. When the metal is in the boiling state, it is known that the more work is put into it the better is the quality of the iron produced; and this work is necessarily better done by the machine than it can be by hand, since the speed of working with the machine is one half greater, and the working is kept up uninterruptedly, without any intervals for rest such as in hand labour, during which the metal would remain stationary in the furnace.

The machine is applied to ordinary single puddling furnaces without any alteration being required in the furnace, the frame of the apparatus being merely attached to the top of the furnace. The double furnace is preferable, however, as it effects a great economy in the consumption of fuel, as compared with a single furnace, and puddles double the quantity of iron in the same time. With the single furnaces at the writer's works, and charges of 5 cwts., the consumption of coal is 28 cwts. per ton of puddled bar made; but with the double furnace and charges of 10 cwts., the consumption of coal is only 17 cwts. per ton of puddled bar, being a reduction of 39 per cent. The number of heats or charges worked in the single furnace is six heats of 5 cwts. each, and in the double furnace five heats of 10 cwts. each, per turn of from nine to ten hours. In working the double furnace it is found best to have one puddler only and two underhands, to avoid the division of responsibility that would arise in the case of two puddlers working the same charge of iron.

The yield of iron in working 5 cwts. charges in the single furnaces is

12 cwts. 2 qrs. 81 lbs. per ton of pig, or 93¼ per cent.; and with the double furnace working 10 cwts. charges, the yield is 18 cwts. 2 qrs. 9 lbs. per ton of pig, or 93 per cent.

Mr. W. Fisher, manager of Mr. Bennett's works, said, in answer to inquiries, that the puddling machines had now been at work constantly during the day for the last six months at the Wombridge Iron Works, and continued to work as well now as they did when they were first started; and there had been no occasion to repair any of the working parts since then, as the machines had been found very simple and strong. A man went round twice a day, and put a little oil on morning and evening; and they could be worked night and day when desired. At first there had been a little difficulty in introducing the machine; but now the men felt its advantage, and were anxious to have it employed on night work also.

The six months' experience of the working of the machine had shown that 5 cwts. of iron had been puddled by it in the time that a man would take to puddle 4 cwts; and it was also found that the machine made a great improvement in the quality of the iron. This was accounted for by the fact that, while in hand puddling there was the liability of the underhands frequently neglecting their work, the machine went steadily on, working the tool constantly to and fro in the furnace, without any intermission, and kept the iron well stirred during the whole time that the work was required to be put into it. The consequence was, that very seldom was a bit of raw iron seen from the puddling furnaces worked by the machine; and the puddled bars were very seldom found to break off short in the rolling, unless the iron were a little too hot. In the heavy operation of puddling, it was impossible for any puddler to stand up to his work as the machine did, since the machine never tired, but kept on steadily at the work without rest, and at a quicker rate of working than in hand puddling. By using the machine to do the heavy part of the work, it was only required for the puddler occasionally to disengage the tool and draw the iron from the sides of the furnace into the centre, leaving the machine during the rest of the time to perform its work alone. When the iron was ready for balling up, the puddler came fresh to the work; and from the men being relieved of the severest part of the labour, the furnaces worked by the machine turned out about 5 cwts. at each heat, and six heats during the day, with the same quantity of fuel as was used for the ordinary heats of only 4 cwts. in hand puddling, with six heats per day. The average result of the day's work with the machine was about 28½ cwts. of puddled iron from 30 cwts. of pig iron, as compared with about 22½ cwts. of puddled iron from 24 cwts. of pig iron, by hand puddling. The improvements effected by the machine were, therefore, that it produced a better quality of iron, with a decreased consumption of fuel, and turned out more iron in the same time. The machine did not interfere with the wages of the underhands, as they had to be employed the same as without the machine; whilst the puddler's wages were increased by his being enabled to turn out more iron in the same time.

THE LONDON INSTITUTION OF FOREMEN ENGINEERS.

September 2nd, 1865.

MR. JOSEPH NEWTON, PRESIDENT, IN THE CHAIR.

THE paper read was, "*On gas lighting in railway and other carriages,*" by Mr. WILLIAM DALZIEL.

THE reader commenced by stating that the subject of artificial illumination is a question that has engaged attention from the very earliest periods, and the advantages accruing to mankind from having the means of obtaining a good light are too well known to need any comment from me. We are now, said the writer, able to travel from one point to another with great facility, and to reach Glasgow from London in 13 hours; but in a journey of that duration we have to submit to many inconveniences, and not the least is that of a bad light, supplied to us from dirty oil lamps. To remedy this state of things several gentlemen have turned their attention to the lighting of railway and other carriages with gas, but the great difficulty has hitherto been the want of space for carrying a sufficient quantity of gas for long journeys.

The most successful of those who have attempted the lighting of carriages with gas, has been, I believe, Mr. Newall, of Lancashire. That gentleman has at the present time in operation on several railways (for short journeys only), an apparatus consisting, in the first place, of an india-rubber bag, of much the same appearance as an accordian bellows, which, when inflated with gas, opens out to its full extent, and then, as the gas is burnt, closes gradually by its own weight, until all the gas is consumed. This bag can be placed on any part of the train or carriage, or in a compartment of a brake van, the latter plan being generally adopted by the various railway companies who have used this plan of illumination.

When the bags are placed in a brake van, the service-pipes are run along the roof of each carriage, the one carriage being connected to the other by means of india-rubber tubing and union-joints, so that the carriages can be connected and disconnected at pleasure. Attached to the service pipes are bracket burners, let into the carriage tops for the purpose of illuminating the interior. When all the fittings are complete in the various carriages, the bags are inflated with gas in the following manner:—

There is placed, in any convenient spot, a large receiver, which is supplied with water from a height (say 30 ft.) by means of a pipe and stop-valve. Another pipe and stop-valve are connected to the receiver, for the purpose of supplying it with gas. There are also two outlet-pipes, fitted with stop-valves, one for water and the other for gas. The outlet-pipe for the gas being carried to the place required for charging the india-rubber bags, a hose pipe is made to connect the bags with the pipes from the receiver. Before filling the bags with gas, it is necessary to expel all the air from the receiver, so as to prevent a possibility of an explosion. To effect this thoroughly, the valves of the outlet gas and inlet water are opened until the receiver is filled; then both are closed, and outlet water and inlet gas are

opened, the vacuum formed by the receding water being filled by the gas from the inlet gas pipe. When the water is all withdrawn from the receiver both valves must be closed, and the connection made with the gas bags, the water-supply and gas-discharge valves being also opened. The water will then rush in, forcing the gas into the bags. When the bags are filled, care must be taken to turn off the valves immediately, or the bursting of the bags from the pressure given by the column of water will follow, the bags not being made to stand much pressure beyond that required for burning. The bags being now filled, all is ready for lighting.

By this plan, for every cubic foot of gas required, one cubic foot of room is needed, the column of water being merely used to facilitate the charging of the bags with gas. If we suppose a train of 20 carriages to be going from London to Glasgow, it would require at least 60 lights, each light burning 3 feet per hour. To supply this quantity of gas, the sole use of 2½ vans, measuring 20 feet long by 7 feet wide and 6 feet high, or a space equal to 2340 cubic feet—or, in fact, one-eighth of the whole train—would be required to store the gas. Another weak point is the liability of the bags to become injured at the corners, such injury being caused by abrasion and the wear and tear of alternate motion. There is also another objection, which consists in the use of water in charging. In using water at a pressure for forcing gas, a large quantity of the illuminating qualities of the gas are absorbed, and the light is rendered very poor. A yet further objection should not be overlooked, viz., that when the bags are charged with gas, if they were allowed so to remain for a number of days, they would in all probability become very dangerous machines, from the fact that air would penetrate through them, and take the place of an equal quantity of gas, leaving the contents a highly explosive compound.

There have been several other plans suggested for the lighting of railway carriages with gas, but not having been able to find out where they have been at work, I am unable to speak with certainty of their merits or demerits. Some are much the same as the gas bags, and some are intended to work high-pressure gas. I have copies of the specifications of two patents, with drawings, &c., which may be examined by yourselves.

It appears to me that gas bags are the best means of railway carriage lighting hitherto in the field, but that there are too many strong objections to their use for them ever to become extensively employed. What is really wanted is a vessel that will carry a large quantity of gas in a small space, and give it out for consumption with uniformity.

I have no doubt you have all heard of the High-Pressure Portable Gas Company, which was started in London many years ago, but when I tell you that there was no difficulty in obtaining at that time high-pressure gas, but that their difficulty consisted in giving an uniform light, you will understand why the Company failed. Their mode of giving light was by means of a peculiarly-constructed cock, which required constant attention and care to keep a regular flame. Now anything that wants much attention will not do for a railway company; therefore it was necessary to construct something which should be at once self-acting and effective, and which would give an uniform light

from a high-pressure holder, no matter what the pressure within it might be, whether 5 lbs. or 500 lbs. per square inch.

Seeing that the bags were not the best appliances possible, I set to work to try if I could not devise something better, and the results of my labours have been that I have now at work on the South Eastern Railway a carriage fitted with apparatus for regulating the pressure of gas with a high-pressure chamber or holder, the cubical contents of which is 8½ feet. This holder, when charged with gas to a pressure of 135 lbs. per square inch, supplied two No. 3 burners for a period of 16 hours, giving an uniform light the whole of the time.

Let me now describe the manner by which this is effected. I have two wrought tubes, 7½ inches bore by 14 feet 6 inches long, with the ends welded up. These are fixed on the bottom of the carriage, and are connected by means of a small pipe to the high-pressure holders. There is an inlet and an outlet pipe. Connected to the outlet pipe I have a regulator fixed. This latter consists of a common gas holder, working in water, the water forming what is known as a hydraulic joint. The regulating holder has an inlet and an outlet pipe, the outlet pipe being carried to the burners in the carriage, and the outlet pipe of the high-pressure holder connected to the inlet pipe of the regulator. Fixed between the inlet of the regulator and the outlet of the high-pressure holder is a slide valve, worked by a lever. The port of the slide valve is of a V shape; and the lever being connected to the regulating holder by means of two rods, when the regulating holder rises it depresses the valve and closes the port; and, on the contrary, when it descends, it lifts the valve and opens the port.

When you charge the high-pressure holder with gas, the gas passes through the high-pressure holder into the regulating holder, and as the regulating holder rises it gradually closes the port; and when the port is closed you continue to charge until you get any desired pressure. When this pressure is attained, all is ready for lighting.

The regulator works as follows:—When the gas is consumed, the regulating holder descends and opens the port, and admits a fresh supply of gas from the high-pressure holder, and continues so to act until all the gas is abstracted from the high-pressure holder, the regulator insuring an uniform light the whole of the time.

The high-pressure holder is charged by means of a force pump, worked by a steam engine, pipes being laid from the pumps to convenient places for connecting the carriages, the connecting media being lead pipes and "unions."

By my arrangement it is thus possible to fit up a carriage with high-pressure holders (every carriage to carry its own) to hold sufficient gas for the supply of two No. 3 burners for 60 hours; or, with the same space at my disposal that is required for gas bags, I could carry ten times more than my present system, and give an uniform light the whole of the time.

It will perhaps still be said, What are the main advantages of the pressure plan over the present system of bags? I answer that:—First,—you may carry the same quantity of gas in one-tenth the space required for the bags. Second,—That the apparatus, being made of iron, is not likely to fail, either by giving a little too much pressure or by being over worked. Third,—All the holders

being required to stand a great pressure, there is no chance of the air getting in and making the contents explosive by the operation of the law of diffusion.

A discussion followed the paper, and this was shared in by Messrs. Usher, Sanson, Ives, Briggs, Edmonds, Lux, the President, and others, Mr. Dalziel replying satisfactorily to criticisms and objections, and finally receiving the thanks of the meeting.

SELECTED PAPERS READ AT THE RECENT MEETING OF THE BRITISH ASSOCIATION AT BIRMINGHAM.

"On the Manufacture of Cast Steel: its Pureness, and Employment as a Substitute for Wrought Iron," by Mr. Bessemer.

The writer alluded to the paper read by him at the meeting of this Association at Cheltenham in 1856, and which created a great sensation at the time in the iron and steel trade; he illustrated by diagrams some of his early experiments, and pointed out the most prominent of the difficulties he encountered. Many forms of "converting vessels" were tried on the large scale before this desirable object was attained. In some of them the lining was too easily broken down by the violent motion of so heavy a fluid as iron; in some of the forms tried, the angles allowed the metal to solidify in them, and so clog up the vessel; in others, the mouth of the vessel being too small, caused the metal to be thrown out by the force of the escaping blast. It was also found that if the mouth was too large the heat escaped so as to cause part of the converted metal to solidify in the vessel; the relative height and diameter of the vessel was also found to produce important differences in the working of the process; finally, after many long and expensive trials, a form of vessel was adopted, made in two parts, to admit easily of its being lined up with a pulverized silicious stone, known as "garrester," which so resists the action of the heat and slags as to last for fully one hundred consecutive charges of steel before it is worn out. The form of the vessel was described—it is mounted on trunnions, supported on stout pedestals, so that a semi-rotary motion may be communicated to it at pleasure. In the fixed vessel first used, any giving way of a few clay tuyeres would stop the process, and cause much inconvenience; but with the movable vessel it is not so, for at any time during the process the vessel may be turned on its axis, and the tuyeres raised above the level of the metal; the blast may then be turned off, the tuyere box opened, and the faulty tuyere stopped up or removed; after which the process may be again resumed. The movement of the vessel on its axis, the

rise and fall of the casting crane, and the other cranes employed for removing ingots from the casting pit, are all effected by a simple hydraulic apparatus, so that the whole process is under the perfect control of a single operator, placed far away from the heat and showers of splashes that accompany the process. Up to this period the manufacture of cast steel by the old as well as the new process is still so far imperfect that steel of the highest quality cannot be made from inferior iron. In the old Sheffield process the original quality of the Swedish charcoal iron employed governs the quality of the cast steel made, consequently £36 per ton is freely given for the high-class Demerara iron, while other brands of Swedish charcoal iron may be bought for £15—in either case, these are expensive raw materials for the cast-steel maker. The paper next referred to the important invention for the town of Sheffield, made in 1839 by Josiah Marshall Heath, who patented that which he described as the "carburet of manganese." Allusion was made to the circumstances which followed the reading of the author's paper in 1856; to the great expectations formed by scientific and practical men; and to the fact that in less than twenty-five days, immediately after the reading of the paper, licences to manufacture malleable iron, under the patent, were purchased by ironmasters to the amount of £25,000. Great excitement took place in the iron trade, and there was a rush to the Patent-office, many persons coveting a share in an invention which seemed to promise so much. Several rough trials of the Bessemer process were made privately by persons in the iron trade, and defects discovered which were supposed by practical men to be perfectly fatal to the invention. Again the press teemed with accounts of the process, but this time it spoke only of its utter impracticability, and of regrets that the high expectations originally formed of it were so fallacious. That there were defects in the process the author had had irrefragable proofs; he set himself to work quietly to remedy them, and at the expiration of three years' incessant labour on the part of himself, and after an expenditure of more than £10,000, the process was again brought before the public. Not the slightest confidence in it was then manifested by the trade; it had been for years agreed on all sides that it was a total failure, and it was looked upon simply as a brilliant meteor that had suddenly flitted across the scientific horizon, leaving the subject in more palpable darkness than before. This entire want of confidence on the part of the trade was most discouraging; one of two things became imperative—either the invention must be abandoned, or the writer must become a steel manufacturer. The latter alternative was unhesitatingly accepted, and Messrs. Bessemer and Co. determined to erect steel works at Sheffield, in the very heart of that stronghold of steel-making. At these works the process has since been successfully carried on; they have become a school where dozens of practical steel-makers received their first lessons in the new art, and are the germ from which the process has spread into every State in Europe, as well as to India and America. By the time the new works at Sheffield had got into practical operation the invention had sunk so low in public estimation that it was not thought worth paying the £50 stamp, due at the expiration of three years, on Mr. Mushet's large batch of manganese patents; they were consequently allowed to lapse, and became public property. The

author has, therefore, used without scruple any of these numerous patents for manganese, without feeling an overwhelming sense of obligation to the patentee. At the suggestion of the author, works for the production of manganese alloys were erected by Mr. Henderson, at Glasgow, who now makes a very pure alloy of iron and manganese, containing from 25 to 30 per cent. of the latter metal, and possessing many advantages over spiegel-eisen, which it will doubtless replace. Two bright rods of 1⅞in. diameter that had been folded up cold under the hammer were exhibited. This extremely tough metal is made by using Mr. Henderson's alloy in lieu of spiegel-eisen, which is incapable of making steel of such a quality. The invention of a Prussian, named Preiger, in manufacturing a new alloy, which had been found useful in making malleable iron by the Bessemer process, was next referred to.

The paper went on to state that the Bessemer cast steel made for ships' plates by the several eminent firms now engaged in that manufacture, is of an extremely tough and ductile quality, while it possesses a degree of strength about double that of the inferior kind of iron plates usually employed in shipbuilding. Hence it is found that a much less weight of material may be employed, and at the same time a greater degree of strength may be given to all parts subjected to heavy strains. Most prominent among the builders of steel ships is the firm of Jones, Quiggin, and Co., of Liverpool, who have now constructed no less than 31,510 tons of shipping, wholly or partially built of steel. Of these, 38 vessels are propelled by steam, with an aggregate of 5910 horse power; besides this, the principal masts and spars of 18 sailing ships have been made by them wholly of steel. Vessels of a large size constructed to Class A A, 12 years, at Lloyds', weigh, when built of iron, about 12 cwt. per ton measurement, whereas similar vessels built of steel weigh only about 7 cwt. per ton measurement; thus, an iron ship to take first class at Lloyds' for 1000 tons measurement, would weigh 250 tons more than a steel one of the same class. Such a vessel could, therefore, take 250 tons, or 25 per cent. more freight at the same cost, or could avail herself of the difference of immersion to leave or enter port, when the tide would not permit an iron vessel to do so. As a steamer, she would carry 250 tons more of coal, and thus be enabled to lengthen her voyage or take her coal for the return trip. The two steel paddle-wheel steamers launched at Liverpool by M. Jones and Co., on the 13th ult., for Dublin and Liverpool service, will draw from 3 ft. to 4 feet less water than iron steamers built on the same lines, and being thus enabled to leave port at all states of the tide, will not require a tidal train in connection with them. If the employment of steel for the construction of merchant vessels is found to be so important, how much more so is it for ships of war? Some of the large class of armour-plated vessels require 6000 tons of iron for their construction, and an addition of 1800 tons in the shape of 4½-inch armour plates. Now, if the frames and inner skin of such a vessel were constructed of steel, it would be much stronger, even if reduced to 4000 tons in weight; this would admit of 9-inch armour plates being used in lieu of 4½, and would still leave the vessel 200 tons lighter than the present ones; and hence, as the resistance of the armour to impact is as the square of the thickness of the plate, we

should have a vessel capable of resisting four times the force of those at present constructed, while it would be 200 tons less in weight. These important facts have not escaped the attention of Mr. Reed, our present talented Constructor of the Navy; and doubtless we shall soon have substantial proof of what may be effected by the employment of steel in the construction of ships of war. The application of steel for projectiles has now become a necessity since the introduction of armour-plates. We have before us a 110-lb. shot that has passed, with very slight injury, through a 5-inch armour plate; and also some specimens of bent angle-iron, made of Bessemer iron, and rolled at the Millwall Iron Works, in London, and from the same works a portion of one of Hughes's patent hollow steel beams for supporting the armour-plating in course of construction for the forts at Cronstadt. Both these are interesting examples of what the rolling mills of the present day can effect, and of the facility with which cast malleable iron and cast steel admits of being worked into the most difficult forms. There is no department in engineering in which the peculiar toughness of steel and its strength and power of resisting wear and abrasion are of such vital importance as in its application to railway purposes. This fact had long since impressed itself strongly on the mind of Mr. Ramsbottom, of the London and North-Western Railway, who commenced experiments with this material in 1861; carefully, though trustingly, he tried it step by step, not even at first venturing to employ it for passenger trains; but as proofs of its safety and economy crowded themselves on him, he carefully applied it to the most important parts of passenger engines, and even to the manufacture of the formidable engine cranks (at that time intrusted only to the most eminent iron-making firms in the kingdom). These iron cranks are now being replaced by steel ones forged from a single mass. One of these steel cranks, manufactured at the new steel works at Crewe, has been obligingly lent by Mr. Ramsbottom, as an illustration of the use of steel for this purpose. That gentleman has also taken out of use a plain steel axle that he has run a distance of 112,516 miles, and now exhibits very slight signs of wear. The tyres of wheels, on which so much of the public safety depends, were then tried, but the exact amount of difference between the endurance of wrought iron and Bessemer steel for this purpose is not yet ascertained, as none of these steel tyres are yet worn out; but enough has been shown to prove the advantage of entirely replacing iron by steel for this purpose. In order to show how a steel tyre will resist the most violent attempts to produce fracture, an example is given of a steel tyre manufactured by Messrs. Bessemer and Co., of Sheffield. It was placed on edge under a six-ton steam hammer, and subjected to a series of powerful blows, until it assumed its present form, that of a figure of 8,—a degree of violence immensely more than it could ever be subjected to in practice. These tyres are made without weld or joint, by forging them from a square ingot, partly under the improved plan invented by Mr. Ramsbottom, and partly by an improved mode of flanging and rolling, invented by Mr. Allen, of the Bessemer Steel Works, Sheffield. So important were found to be the advantages of employing cast steel as a substitute for wrought iron

at the works of the London and North-Western Railway Company, that the directors, acting under the advice of their able engineer, determined on building large steel works at Crewe, which are now in active and successful operation. In the design and arrangement of their plant for working up the steel, several important improvements have been introduced by Mr. Ramsbottom; among others his duplex hammer, which strikes a blow on both sides of the ingot at once in a horizontal direction, and thus renders unnecessary the enormous foundations required for ordinary hammers. Here also he has put up his improved rolling mill, for rolling blooms of large size, the enormous machine being reversed with the greatest rapidity and ease by the attendant, without any shock or concussion whatever. While matters were thus steadily progressing in the engine department of the company, the engineer of the permanent way, Mr. Woodhouse, took in hand a thorough investigation of a no less important problem, viz., the substitution of cast-steel for wrought-iron railway bars. For this purpose, some 500 tons of rails were made and put down at various stations where the traffic was considerable, so as to arrive at the earliest period at a true comparison of the respective endurance of wrought-iron and cast-steel rails. It will be unnecessary here to enter into the numerous details of the extensive series of experiments systematically carried out by Mr. Woodhouse, since the trials made at Camden will suffice to show the extraordinary endurance of steel rails. It is supposed that there is not one spot on any railway in Europe where the amount of traffic equals that at the Chalk Farm Bridge, at Camden Town. At this spot there is a narrow throat in the line, from which converges the whole system of rails employed at the London termini of this great railway. Here all passenger, goods, and coal traffic has to pass. Here also the making up of trains and shunting of carriages is continually going on. At this particular spot two steel rails were fixed on the 2nd of May, 1862, on one side of the line, and two new iron rails were on the same day placed precisely opposite to them, so that no engine or carriage could pass over the iron rails without passing over the steel ones also. When the iron rails became too much worn to be any longer safe for the passage of trains, they were turned the other way upwards, and when the second side of the iron rails was worn as far as the safety of the traffic would allow, the worn-out rail was replaced by a new iron one, the same process being repeated as often as was found necessary. Thus we find at the date of the last report, on March 1st, 1865, that seven rails have been entirely worn out on both faces. Since then another rail has been worn out up to July, making sixteen faces worn out, the seventeenth face being in use on August 22nd, when the steel rail lying on the table was taken up in the presence of the writer. The first face of the rail only has been used, and this is now become much thinner than it was originally, but in the opinion of the platelayers is still capable of wearing out another half-dozen faces; taking its resisting powers at three more faces only, it will show an endurance of 20 to 1 in favour of steel. Mr. Woodhouse has ascertained, by careful and continued testing of twenty-four hours at a time, that an average of 8082 engines, tenders, or carriages, pass over the steel rails every twenty-four hours, equal to 16,164 wheels every day for 1207 days, making a total of 9,754,974 wheels

passed over the rail. Subject to this excessive wear, the rail appears to have been reduced 7½ lbs. per yard; hence, for every grain in weight of steel lost by abrasion, no less than 371 wheels had to pass over it. Another steel rail, put down also in May, 1862, at a place much less subject to wear, has had four faces of iron rails worn out opposite to it, and still appears as if very little used. This rail is also placed on the table. An iron rail wears out by the giving way at various parts of the imperfectly-welded mass, and not by the gradual loss of particles of metal, as in the case of the steel rail, which no amount of wear and tear seems capable of disjointing. It must be borne in mind that this enormous endurance of cast steel is not owing to its hardness or brittleness, as some have supposed, for, in fact, Bessemer steel possesses an extreme degree of toughness. There is before the meeting an example of this fact. One of the same quality of steel rails was attached at one end to the main driving shaft of a steam-engine so as to twist it while cold into a long spiral measuring 9 ft. in length at top and bottom, and only 6 ft. if measured along the centre of the web. A single glance at this spiral rail will, it is presumed, dispel any idea of brittleness that may have been entertained. Cast steel is now being used as a substitute for iron to a great and rapidly-increasing extent. The Jury Reports of the International Exhibition of 1851 show that the entire production of steel of all kinds in Sheffield was at that period 35,000 tons annually, of which about 18,000 tons were cast steel, equal to 346 tons per week; the few other small cast-steel works in the country would probably bring up this quantity to 400 tons per week as the entire production of cast steel in Great Britain. The Jury Report also states that an ingot of steel, called the "monster ingot," weighing 24 cwt., was exhibited by Messrs. Turtin, and was supposed to be the largest mass of steel ever manufactured in England. Since that date a great change has been made, for the largest Bessemer apparatus at present erected in Sheffield—at the works of Messrs. John Brown and Co.—is capable of producing with ease, every four hours, a mass of cast steel weighing 24 tons, being twenty times larger than the "monster ingot" of 1851. There are now seventeen extensive Bessemer steel works in Great Britain. At the works of the Barrow Steel Company, 1200 tons per week of finished steel can easily be turned out; and when their new converting house, containing twelve more 5-ton converters, is completed, these magnificent works will be capable of producing weekly from 2000 to 2400 tons of cast steel. There are at present erected, and in course of erection in England, no less than 60 converting vessels, each capable of producing from 3 to 10 tons at a single charge. When in regular operation, these vessels are capable of producing fully 6000 tons each of steel weekly, or equal to 15 times the entire production of cast steel in Great Britain before the introduction of the Bessemer process. The average selling price of this steel is at least £20 per ton below the average price at which cast steel was sold at the period mentioned. With the present means of production, therefore, a saving of no less than £6,240,000 per annum may be effected in Great Britain alone, even in this infant state of the Bessemer steel manufacture.

"On Weldless Tyres, Circular Rolling, and Railway Wheels," by Mr. F. J. Bramwell.

The writer gave an account of the mode of making tyre hoops for railway wheels, prior to the invention of weldless tyres, and pointed out the objections to which that and other modes were open. He then proceeded to describe the mode in which, in the year 1844, he proposed to make tyres without a joint weld, now known as weldless tyres. This mode consisted in winding a long bar of iron into a helical coil, of very nearly the size and shape of the required finished tyre hoop, and then in placing this coil in a circular furnace, having an opening or "gash" of the form of the sector of a circle. When seen on plan such sector subtended about 60° or 90°, and placed within it was a quick-going mechanical hammer, provided with tools of nearly the shape of the finished tyre, and adapted to operate on that portion of the hoop that lay out of the furnace and in the sector. By this means the writer proposed to weld the whole circumference of the coil, by bringing welding hot portions successively out of the interior of the furnace into the sector-shaped gash. The ring forging thus made, he finished off by means of the circular rolling machine, which had been invented by Mr. Bodmer, in the year 1839, and which, as far as the writer knew, was the first machine ever devised by which the continuous or "circular" rolling of a ring could be effected. He pointed out that Mr. Bodmer did not propose to make a weldless ring, but, on the contrary, intended to make that ring by welding together the ends of a bar, while the object of his invention was to finish tyres by rolling instead of by turning them in a lathe. The writer then stated, that though between the years 1844 and 1855 some few persons brought forward propositions for making weldless tyres, nothing really was done, so far as he knew, between those dates, in the way of manufacturing them. In the latter year, the writer made a proposition on the subject to Mr. W. Owen, of Rotherham, a large manufacturer of railway wheels, who, after long consideration, commenced to make weldless tyres in the year 1861. The Blaenavon Company commenced the manufacture about the same period. Prior to this, viz., in 1856, the manufacture of these tyres was commenced by Jackson, Petit, and Gaudet, in France. Mr. Owen, and the limited company who had succeeded him, had carried out the making of weldless tyres to a very large extent, using machinery, nearly the whole of which had been designed by the writer. At present only very few mills were working upon the same plan, but several were preparing machinery for the purpose. The paper then described the process of making weldless tyres, as adopted by the Owen Company. It consisted of making a helical coil of about half the diameter and three times the width of the intended tyre. This coil to be heated in a furnace, and then put into a mould on the anvil of a steam hammer, and (by the action of the top tool upon it) welding it into a ring blank, about half the diameter and twice the thickness of the finished tyre. The process was finished by the removal of this block to a circular rolling machine, on Bodmer's principle, but combined with hydraulic power of such character as to be capable of rolling out the tyre to its proper decreased thickness and increased diameter. The paper then went on to show that not only was the manufacture of

weldless hoops completed by circular rolling, one that ensured soundness and safety, but that also, in consequence of dispensing with the "crop ends," and of the passing backwards and forwards of the bar being rolled, both of which accompany and are drawbacks to ordinary rolling, such manufacture of weldless hoops was really an economical mode, and might be advantageously employed in the manufacture of all heavy straight bars, rails, and plates, which would in the first instance be rolled into the ring form, and then that ring, being cut through, would be flattened out in the same way that sheets of glass were made by laying open the cylinder, into which shape the glass was first formed. The paper pointed out how beneficial the use of weldless rings would be for boiler work, as they would dispense with the longitudinal seams, which were the source of weakness in boilers. The paper then described the improvement in manufacturing solid wrought-iron wheel centres, invented by M. Arbel, of France, and practised by the Owen Company. It consisted of putting together the various parts forming the rim, spokes, and boss, and heating the same in a furnace, from which they were removed into a die to be welded by the action of a powerful hammer, having (when its moving parts were fitted so as to make the centres of engine wheels) a weight of more than 25 tons, and a maximum drop of 6 feet. The paper also described a common kind of wheel centre in very general use, wherein wrought-iron spokes were combined with a cast-iron boss; and pointed out the objection to this mode. It then stated the improvement of M. Lahousse, of Belgium, as practised by the Owen Company, by which the advantage of a wrought-iron boss can be obtained at a rate as economical as that of a cast-iron boss, and showed that this was done by enveloping cold or moderately-heated wrought-iron spokes in the highly plastic halves of a welding-hot wrought boss, by which the spokes were firmly embraced and held fast. The paper concluded by expressing the conviction on the part of the writer, that on account of the greater safety of weldless tyres, they would come into universal use; and that though the sort of conservatism arising from the investment of capital in machinery, which would be displaced by a new invention, might delay its general adoption, the force of public opinion would in the end set aside the present process of manufacture, and lead to the adoption of that which he described.

"ON THE STATISTICS OF THE SMALL ARMS MANUFACTURE OF BIRMINGHAM," by Mr. J. D. GOODMAN.

AFTER glancing at the early history of this manufacture, the author stated that of workmen employed he estimated the total number at 7340. Of these, 3420 are engaged in producing the materials,—the barrel employing 700, the lock 1200, the bayonet 500, and so on. Setting up these materials into guns employs 3920 men. Of these, the three chief branches are the stockers, screwers, and finishers. Each of these branches, with its sub-branches, is estimated to employ 1000 men. The stocker lets the barrel and lock into the stock, and roughly shapes the stock. The screwer lets in the furniture and remaining parts of the gun, and further shapes the stock. The finisher

takes the gun to pieces, and distributes the several parts to the browner of the barrel, the polisher, the engraver, &c.; and when they are returned, he puts the gun together, and finally adjusts the several parts. The out-working system leads to the employment of a considerable number of young boys, who are employed mainly in carrying the work from one to another as it passes through its several stages. No very correct estimate can be given of the rate of wages earned by the workmen in the gun trade. With very few exceptions, the work is paid for by the piece, and the rate varies considerably with the demand. During the past ten years there is little doubt but that the wages earned in this trade have probably exceeded those in any other. Several branches require very high skill, and the remuneration is in proportion; for instance, barrel boring and setting, stocking, rifling, lock-filing, &c. A judgment can be formed of the delicacy of workmanship required in the first of these branches, when it is stated that a military barrel has to be bored with such truth that it must receive a plug measuring 577-thousandths of an inch, and is condemned as useless if it take one of 580. A workman in this branch in full employment has frequently been known to earn his £5 to £6 a week. It is a very common practice in many of the branches for a workman to employ several assistants, whether working in the factory of his employer or as an out-worker. Such men, while paying those under them at the rate of *5s.* to *10s.* for boys, and adults *15s.* to *25s.* per week, will take for their own share several pounds. A workman is held to be an inferior hand who in any of the skilled branches cannot earn single-handed *30s.* per week. The Birmingham gun makers have long been aware that a more extensive use must be made of the advantages which they possess, and this has led to the erection in Birmingham of an establishment for the manufacture of guns by machinery, on the interchangeable principle. We must give America credit for the introduction of this system. It was thence that it was brought into this country. The attention of the English Government was first called to the subject by a commission, of which Mr. Whitworth and Mr. G. Wallis, late head master of the Birmingham School of Art, were members. The factory of the Birmingham Small Arms Company is now in working operation. The system is there carried out in its full integrity. It has been planned on a scale to produce 1000 guns per week. There are upwards of 300 machines at work, but at present it has not reached its full power. The number of guns now made there is about 500 per week. From a return published of the number of barrels made for the Government in the years 1804 to 1815, the total was 3,037,644, or an average number of 253,137 annually. In 1804 the number produced was 80,000. It steadily increased up to 1813, when it reached 490,000 in that one year made for the Board of Ordnance alone. During this period Birmingham produced barrels and other materials for the East India Company, amounting to a million. This makes the total number of arms made in the twelve years somewhat over 4,000,000, or 1074 per working day. A large number of the materials manufactured in Birmingham were made up into guns by the London gun makers. To verify the traditional "gun a minute," said to have been the production of Birmingham during this war, we require 1440 guns per day, or 525,000 per year. For this we must

confine ourselves to the two highest years, 1812 and 1813, which produced respectively, including the India Company's supply, 581,682 and 654,450. It will be instructive to compare with the results now given the production of the French Government during the same period. The information is obtained from returns published in 1822 by M. Dupin, a field officer in the French service. During the years 1802 and 1814, a period of 13 years, the arms manufactured by France numbered 2,456,257, or about 200,000 annually. This number gives us for every working day 604 guns. The number made in England, it will be recollected, being 1074 per working day. At this time it must be borne in mind that France had at her command the resources of Liège and Turin, in addition to her own. St. Etienne, the most important seat of the arms manufacture in France, supplied 754,000, while Liège produced 279,900, and Turin 107,000. Seven other towns supplied the remainder. The total number of guns proved in the period from 1859 to 1864 was 6,116,305. Of this number there were proved at the Birmingham trade proof-house, 3,277,815; at the Government proof-house at Birmingham, 978,249 (these last represent military guns made for the English service); at the London proof-house, 1,325,139; and at the Enfield factory, 505,102. The Enfield factory has only been in operation seven years. The average annual production will thus be:—Birmingham trade proof-house, 327,781; Birmingham Government proof-house, 97,824; London trade proof-house, 135,513; Enfield proof-house, 72,154; making a total annual production for the whole of England of 633,272. As to the number of guns supplied to America during the war, the writer of the paper said,—"From the returns I have in my possession I have drawn out, as accurately as I possibly can, the number of arms manufactured in Birmingham and elsewhere for the Americans during the last four years. The first shot was fired at Fort Sumter on the 12th of September, 1861. On the 9th of May following, five purchasers of arms, some commissioned by different Northern States, others private speculators, arrived in Birmingham. Each had so well kept secret the object of his mission, that when they found themselves all engaged in Birmingham on the same errand, they suspected each other of purchasing for the enemy, and their anxiety was increased accordingly to secure the few thousand arms that were then in store in Birmingham. The few in hand were at once shipped off, and large orders were given, which continued to occupy the trade at their full power, with one interval, till March, 1863. The interval I allude to was on the occurrence of the Trent affair in November, 1861, which led to an embargo being laid on the export of arms on December 4th, 1861. This embargo was removed early in 1862. On the removal of the embargo, one steamer took out from Southampton no less than about 40,000 rifles to New York. The trade worked at its full power, straining every nerve till, I find by the return from the Birmingham proof-house, that in one month, the month of October, 1863, 60,345 rifle barrels were proved, being very few short of 2000 per day from Birmingham alone,—a number altogether unprecedented in the history of the trade. At that time the supplies produced in America at the Springfield Armoury, and elsewhere, began to tell on the demand. We still find, however, that the numbers were 40,000 to 50,000 per month, till March, 1863. They then fell to 14,000 per

month, till in September, 1863, the Northern demand ceased altogether. Without notice the orders were suspended, and guns that had been sent over were even returned to this country. The United States' Government found at that time their factories were equal to supply the whole demand. From the proof-house returns I obtain the following numbers, showing the extent of the supply of arms from this country to America:—Birmingham supplied 682,534; London, 344,802; making a total number of Enfield rifles sent to America of 1,027,336. The price of the arms manufactured by the English trade for Government use he estimated at £3. Data were given of the number of guns made in Belgium and England; and as to the future the paper said,—"It is manifest that the Birmingham gun trade must be on the alert if it is to maintain its ground. To contend against the cheap labour of Liege is not an easy task. The establishment of the machine factory, we hope, is a step in the right direction. It will secure for the town the trade in the highest class of military work, which otherwise would have gone to our competitors. Excessive prices for labour are still paid in certain branches of the work, particularly when sudden pressure comes upon the trade. A more uniform rate of wages would benefit all parties, and the master would feel more confidence in tendering for contracts at moderate rates, and the workmen would secure more regular employment. I hope the facts now produced, and which will subsequently be given more in detail, will serve to call the attention of the trade to points so closely affecting its future progress and well-doing."

Provisional Protection Granted.

1865.

[*Cases in which a Full Specification has been deposited.*]

2130. James Stevenson, of Salisbury-street, Strand, impts. in steam engines,—a communication.—*August 18th.*

2153. Gideon G. Dennis, of Boston, U.S.A., impts. in friction matches, lucifer matches, and matches for relighting, called taper matches.—*August 21st.*

2203. Henri Adrien Bonneville, of Paris, impts. in the construction of apparatus for distilling and rectifying alcohols,—a communication.

2204. Henri Adrien Bonneville, of Paris, impts. in the manufacture of velvet, and in the apparatus employed therein,—a communication.

2205. Henri Adrien Bonneville, of Paris, impts. in the construction of presses for the compression of elastic substances,—a communication.

The above bear date August 28th.

2221. Washington Parker Gregg, of Boston, Massachusetts, U.S.A., impd. roller skate.—*August 29th.*

2245. Oliver Bennett, of Framingham, Massachusetts, U.S.A., steam blower or blast apparatus for furnaces,—a communication.—*August 31st.*

2270. Stephen Kettle, of Goswell-street, Clerkenwell, impts. in water-closet apparatus, urinals, and the like, and the appliances thereto.—*September 4th.*

2314. John Casthélaz and Nicolas Basset, of Paris, impts. in the manufacture of oxalic acid.

2315. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in the manufacture of flexible tubing or hose,—a communication.

The above bear date September 9th.

Cases in which a Provisional Specification has been deposited.

1044. Gaspard Alfred Montenat, of Paris, apparatus for ejecting and spreading liquids and powder. — *April* 12*th*.

1180. Anthony Francis, of Saint John's Wood, impd. apparatus for condensing steam and feeding boilers with the product therefrom.—*April* 27*th*.

1497. Frederic Newton Gisborne, of West Strand, impts. in apparatus for indicating the pressure of steam or liquids in gauges, and for signalling. —*May* 31*st*.

1533. Charles De Bergue, of the Strand, impts. in the manfacture of iron piers or erections, applicable more especially for carrying bridges at high elevations, or available for sheer legs and lighthouses.—*June 5th*.

1624. Phineas Lawrence and George Jefferys, of New York, U.S.A., impts. in copying presses.—*June* 15*th*.

1634. William Deltour, of New York, impt. in the preparation of vegetable fibre for the manufacture of paper.—*June* 17*th*.

1740. Henry William Rosser, of Leadenhall-street, impts. in the mechanical arrangement of water-closets for ships. —*June* 30*th*.

1920. Herbert William Hart, of the Strand, impts. in metal pins.

1922. James Leetch, of Oxford-street, impts. in crinolines.

The above bear date July 24*th*.

1935. Thomas Spencer, of Euston-square, impts. in the preparation of soils to promote general vegetation.

1946. Tobiah Pepper, of Newington-green, impts. in the manufacture of anti-flammable starch.

The above bear date July 26*th*.

1947. Pierre Alexis Francisse Bobœuf, of Paris, impts. in the preparation and application of certain coloring matters.

1952. Henry Sherwood, of Hatcham, Surrey, impts. in the means of, and apparatus for, treating animal and vegetable fibrous materials; which apparatus is also applicable to various useful purposes.

The above bear date July 27*th*.

1954. William King, of Woodside, Finchley, impts. in apparatus for retarding the progress of railway carriages and trains.

1956. William Edward Newton, of Chancery-lane, impts. in conical plug steam valves,—a communication.

The above bear date July 28*th*.

1963. Baldwin Latham, of Croydon, and Robert Campbell, of Buscot-park, Berkshire, impts. in drying grass, hay, and other substances, and in the machinery for effecting the same.

1964. Ephraim Sabel, of Moorgate-street, impts. in the manufacture of iron,—a communication.

1968. Ferdinand Küp, of Frankfort-on-the-Maine, impts. in gas burners.

1970. William Worthington Biggs, of Paris, impts. in the manufacture of iron.

The above bear date July 29*th*.

1972. Benjamin Robinson, of Stainland, near Halifax, and Joseph Varley, of Mold Green, near Huddersfield, impts. in means or apparatus for promoting the combustion of fuel in furnaces of steam boilers, dyers' or brewers' pans, and other furnaces, whereby smoke is prevented and fuel economized.

1973. John James Stoll, of Champion-terrace, Tulse-hill-road, Brixton-hill, self-generating continuous motive-power.

1975. John Ramsbottom, of Crewe, impts. in the manufacture of hoops and tyres, and in the machinery employed therein.

The above bear date July 31*st*.

1983. Thomas William Tobin, of Watson's-road, Wood-green, and Colonel Stodare, of the Egyptian Hall, Piccadilly, impd. apparatus for illusory exhibitions.

1984. Francis Ross Wells, of Hastings, impd. method of producing a photographic image on the surface of copper or other metal plates.

1987. Alexander Doull, of Westminster, impts. in the construction of atmos-

pheric railways and carriages, and in working the same.

1988. William Singleton, of Sheffield, impts. in apparatus for cutting scales for knives, and forming metal webs for knives.

1989. Andrew Noble, of Newcastle-upon-Tyne, impts. in fuzes for shells.

1991. Frederic Ransome, of Queen-street-place, impts. in roofing tiles and slabs.

The above bear date August 1st.

1996. James McEwan and William Neilson, both of Glasgow, impts. in the raising, lifting, or drawing and forcing of water and other liquids, and in the apparatus and means employed therefor.—*August 2nd.*

2012. Ephraim Sable, of Moorgate-street, impts. in machinery to be used in the manufacture of plate or sheet iron,—a communication.

2014. Henry Duncan Preston Cunningham, of Alverstock, Hants, impd. method of working guns.

2016. William Henry Preece, of Southampton, impts. in railway electrical signal apparatus.

The above bear date August 3rd.

2022. John Gaukroger, of Hebden Bridge, Yorkshire, and John Dodgeon, of Burnley, impts. in machinery or apparatus for sizing, drying, and beaming yarns of cotton or other fibrous substances.

2024. Emil Wild and Wilhelm Wessel, of Berlin, impts. in wick-holders or burners for lamps.

2026. Thomas Staley Raney, of Boston-street, Dorset-square, impts. in securing roof lamp-glasses of railway and other carriages, which impts. are also applicable to lighting the decks of ships and other situations.

2028. Henri Adrien Bonneville, of Paris, impts. in the construction of axle boxes and bearings,—a communication.

2030. Thomas William Webley, of Birmingham, impts. in breech-loading fire-arms, and in revolving fire-arms, and in cartridges.

2032. Alfred Vincent Newton, of Chancery-lane, impts. in machinery for manufacturing cigars,—a communication.

The above bear date August 4th.

2034. Hubert Cyrille Baudet, of Paris, impd. keyed musical instrument.

2036. Henry Geering, of Birmingham, impts. in the sackings of metallic and other bedsteads, sofas, couches, and other like articles; which said impts. may also be applied to the seats of chairs, railway carriages, and other articles,—a communication.

2038. John Henry Johnson, of Lincoln's-inn-fields, impts. in the ornamentation of glass, and in the application of glass so ornamented,—a communication.

2040. Adolph Millochau, of New York, impt. in stills for the distillation of petroleum and other oily substances.

The above bear date August 5th.

2042. Abraham Follet Osler, of Birmingham, impts. in lamps for burning paraffin oil and other volatile oils.

2043. Adrienne Anastasie Foubert, of Saint Helier's, Jersey, impts. in apparatus for regulating the passage or flow of water, steam, and other fluids.

2044. William Pollock and John Stobo, of the Leven Bank Works, Dumbartonshire, impts. in the apparatus for washing yarns.

2048. William Clark, of Chancery-lane, impts. in apparatus and fittings to be used in ships for facilitating the loading, unloading, and stowage of their cargoes,—a communication.

2050. William Castle Dodge, of Washington, impts. in fire-arms.

The above bear date August 7th.

2052. Horatio Fletcher and George Gore, of Gateshead, impts. in apparatus for communicating and signalling between passengers, guards, and drivers of railway trains.

2054. William Reid Corson, of Manchester, impts. in the construction of shop fronts and other similar parts of buildings.

2056. William Rock, of Walworth, impts. in printing machines.

2058. Samuel Middleton, of Shoemaker-row, Doctors'-commons, impd. arrangement of machinery for brushing hair.

The above bear date August 8th.

2059. Jacob Henry Radcliffe, of Oldham, impts. in the lubricating of

spindles, the necks or bolsters in which the said spindles revolve having a traversing motion in the said neck or bolster.

2060. George Harvey and Alexander Harvey, junior, of Glasgow, impts. in machinery for screwing bolts and nuts.

2062. Henry Cartwright, of Broseley, Salop, impts. in the construction of steam engines.

2065. Arnold Budenberg, of Manchester, impd. apparatus for adjusting levels and other instruments,—a communication.

2068. James William Sumner, of Vauxhall-bridge-road, and Clement Augustus Scott, of Brompton, impts. in the manufacture of bricks and blocks for building and other purposes.

2070. Ludwig Shad, of Warrington, impts. in the production of violet colors from magenta, for dyeing and printing.

The above bear date August 9th.

2071. Mark Henry Blanchard, of Blackfriars-road, impts. in the manufacture of terra-cotta, or vitreous stone.

2072. Thomas Frederick Henley, of Pimlico, impts. in heating and evaporating,—partly a communication.

2073. John Ingham, Henry Ingham, and James Broadley, of Halifax, impts. in looms for weaving.

2075. Carl Johann Reinhart Jähns, of Berlin, impts. in mounting telescopes and microscopes.

2077. Thomas Allcock, of Birmingham, impts. in machinery to be used in the manufacture of stair rods.

2078. Joseph Faren, of Belfast, impts. in the process of, and machinery for, cleaning China grass and flax, and removing therefrom the resinous and woody matters that adhere to the useful fibres of the plant.

2079. William Edward Newton, of Chancery-lane, impts. in machines for making eyelets,—a communication.

The above bear date August 10th.

2081. Peter Carlsson Kjellberg, of Christianstad, Sweden, impts. in the mode of fixing safes, boxes, or other depositories for the protection of papers or other materials from fire.

2083. Richard Archibald Brooman, of Fleet-street, impts. in treating and printing threads employed in weaving,—a communication.

2084. Robert Williams Armstrong, of Belleek, Fermanagh, impts. in machinery for moulding hollow articles in earth, clay, and other like materials.

2085. John Henry Johnson, of Lincoln's-inn-fields, impts. in the manufacture of candles,—a communication.

2087. Horace Jee, of Liverpool, impts. in the manufacture of table salt.

2086. Thomas English Stephens, of Liverpool, impts. in, and applicable to, railway carriages, to enable passengers to pass from one compartment to another, and to give signals on trains in motion.

The above bear date August 11th.

2089. Jonas Tatham and John Smith, of Rochdale, impts. in machinery for preparing cotton, wool, and other fibrous materials.

2090. James Knowles, of Eagley Bank, near Bolton, impts. in machinery for lubricating the axles of colliery and other similar waggons or trucks.

2091. William Bullough, of Blackburn, impts. in looms for weaving.

2092. William Edward Newton, of Chancery-lane, impd. burglar-proof lock,—a communication.

2094. Henry Woodward, of Cannon-street, impts. in gas burners.

2095. Henry Woodward, of Cannon-street, impts. in carburetting coal gas, and manufacturing artificial gas, and in the machinery or apparatus employed therein.

The above bear date August 12th.

2096. Robert Alexander William Westley, of Camden-road, Camden-town, a combination of improved method, apparatus, and receptacles for storing, preserving, transferring, and discharging certain fluids for sanitary and protective purposes.

2097. Frederick Brampton, of Birmingham, impts. in files or holders for holding letters and music, and for other like purposes.

2099. William Frederick Henson, of New Cavendish-street, impts. in railway chairs.

2100. James Thomas Lockey, of Sutton, near St. Helen's, impts. in, and connected with, the manufacture of copper.

2101. John Gallemore Dale, of Warrington, and Richard Samuel Dale, of Manchester, impt. preparation for the prevention of forgery of bank cheques, bills, and other documents.

The above bear date August 14th.

2103. Reuben Cornelius Lilly and James Sunderland, of Birmingham, impts. in fastenings for sleeve links, solitaires, brooches and other articles of jewellery.

2104. John William McDermott, of New York, impts. in bolt-heading machines.

2105. John Frederick Boetius, of Smethwick, impts. in furnaces to be used in the manufacture of glass, iron, and steel, and for other like purposes,—a communication.

2108. James Broun, of Greenock, N.B., impts. in revolving fire-arms, in projectiles, and cartridges.

2109. William Oldfield Wilson and Joseph Wilson, of Liverpool, impts. in self-acting apparatus for extinguishing fire and sounding fire alarms.

2110. Michael Henry, of Fleet-street, impts. in the production of surfaces by means of photography,—a communication.

The above bear date August 15th.

2111. James Billings, of Kentish-town, impts. in ventilators.

2112. William Clark, of Chancery-lane, impts. in apparatus for taking measurements,—a communication.

2113. John Smith, of Baxenden, Lancashire, and William Schofield, of Heywood, Lancashire, impts. in machinery used in washing, bleaching, and dyeing yarns and textile fabrics in the bank.

2114. John Ingham and John Culpan, of Bradford, impts. in the treating of China grass or other vegetable fibrous substances.

2115. William Gadd, of Nottingham, and John Moore, of Manchester, impts. in looms for weaving.

2116. John Henry Johnson, of Lincoln's-inn-fields, impts. in machinery or apparatus for the manufacture of paper bags,—a communication.

2118. William West, of St. Blazey, Cornwall, impts. in preparing lubricating compounds.

2119. James Bryce Brown, of Cannon-street, impts. in lawn mowing machines.

The above bear date August 16th.

2121. Samuel Phillips and Joseph Groves, of Birmingham, impts. in the manufacture of safes.

2122. Abraham Akeroyd and Jonathan Lister, both of Bradford, impts. in shuttles for weaving purposes.

2123. Oscar Laurence, of Euston-road, medicine for the cure of the diseases of the stomach (dyspepsy, cardialgy, indigestion) and the hemorrhoids.

2124. Frederick John Jones, of Aldermanbury, impd. fastening for leggings or other articles.

2125. Eugene Rimmel, of the Strand, impt. in the manufacture of metallic capsules.

2127. Alfred Vincent Newton, of Chancery-lane, impd. mode of, and apparatus for, drying timber, grain, and other marketable products,—a communication.

2128. Nicholas Charles Szerelmey, of Belgrave-road, Pimlico, impts. in the manufacture of paper boards and pipes.

The above bear date August 17th.

2129. George Hedgecombe Smith, of North Perrott, Somersetshire, impt. in dyeing and preparing hemp and other fibres, for the manufacture of yarns and other fabrics.

2135. Arthur Young and William Young, of Gower-street, impts. in type-distributing and composing machines.

2136. William Edward Gedge, of Wellington-street, Strand, impd. machinery or apparatus for reducing the thickness of parts of calf skins or of other skins or hides,—a communication.

2138. George Howard, of Berners-street, Oxford-street, impd. method or process for ornamenting walls and other surfaces of buildings,—a communication.

2139. Joseph Lionel Naish, of Brighton, impd. apparatus for illustrating astronomical phenomena.

2141. John Hope, of Reading, impts. in packing cases or boxes for holding or packing bottles or bottled liquids.

The above bear date August 18th.

2143. William Wood and James William Wood, of Monkhill, near Pontefract, impts. in the manufacture of pomfret cakes, rolls, and pipes, and of lozenges, and in apparatus to be used in the manufacture of such articles.

2144. John Samuel Watson, Albert Horwood, and Charles Brumfit, of Pall-mall West, impts. in constructing constant galvanic batteries for giving a signal or alarm in case of fire, and any other telegraphic purposes.

2145. George Whitford, of Acacia-road, a toy or game called "flying fish."

2146. Charles Edkins, James Newman, and Thomas Greaves, of Birmingham, impts. in the manufacture of buttons.

2147. Richard Archibald Brooman, of Fleet-street, impd. method of twisting threads,—a communication.

2149. William Edward Newton, of Chancery-lane, impts. in machinery for making bricks,—a communication.

2150. James Battle Austin, of Victoria Wharf, Earl-street, Blackfriars, impts. in apparatus for stopping bottles.

2151. William Soper, of Reading, impts. in breech-loading fire-arms.

The above bear date August 19th.

2155. Fleeming Jenkin, of Duke-street, Adelphi, impts. in machinery to be used in the manufacture of telegraph cables.—*August 21st.*

2156. Daniel George Staight and Stephen Staight, of Charles-street, Hatton-garden, impt. in the manufacture of keys for pianofortes and other musical instruments requiring such keys.

2157. James Alfred Turner, of West Gorton, near Manchester, impd. covering for rollers or cylinders.

2158. John Lockwood, of Leeds, impts. in steam boiler and other furnaces.

2159. Frederick Charles Bryan Robinson, of Carlisle, impd. safety couplings for railway carriages.

2160. Manuel José Lopez y Munoz, of Cuba, impts. in machinery for making cigarettes.

2161. Charles Marsden, of Kingsland-road, impts. in the construction of electric telegraph cables, and in the preparation of telegraph wires.

2162. Derwas Owen Jones, of Pontesford, Salop, impd. apparatus to facilitate the cleansing and examination of the bottoms of ships and other submerged structures.

2163. John Gilbert Avery, of Regent-street, composition suitable for use as paint and protective coating,—a communication.

The above bear date August 22nd.

2165. Henry Willis and George Rice, of Worcester, impts. in sewing machines, and in winders for sewing machines.

2166. John Howard Scott, of West Gorton, near Manchester, impd. furnace for annealing iron and steel wire or rods.

2167. John Newton, of Preston, impd. gully or stench trap for the prevention of the escape of noxious effluvia from drains or sewers, and for preventing the ingress of sand or other solid matters into the same.

2168. Lippmann Jacob Levisohn, of Powell-street West, Goswell-road, impt. in syphons.

2170. Donald McKellar, of Glasgow, impts. in lithographic and copperplate printing, and in the machinery or apparatus connected therewith.

2171. Edward Henry Cradock Monckton, of Dublin, impts. in the manufacture of the straw of rye, and other straws and grasses, into fibre, and utilising the refuse.

The above bear date August 23rd.

2173. John Moody, of Goole, Yorkshire, impts. in floating lights, beacons, floating batteries, and other vessels.

2174. David Davies, of Crumlin, Monmouthshire, impts. in steam hammers.

2175. William Colborne Cambridge, of Bristol, impts. in the manufacture of steel, iron, and metal suitable for bearings, and in apparatus for the same.

2176. Frederick Thomas, of Bishopsgate-street Within, impts. in the method of heating the ovens and boilers of kitchen ranges or cooking stoves.

2177. Frederick Ayckbourn, of South-

ampton-street, Westminster, impts. in stockings.

2178. William Edward Newton, of Chancery-lane, impts. in well-sinking tubes,—a communication.

2179. Giacomo Bagnagatti, of Leicester-square, impt. in gas burners.

The above bear date August 24th.

2181. Lemuel Clayton, of Stamford-street, impts. in the manufacture and ornamenting of carpets, rugs, and other fabrics.

2182. Henry Henson Henson, of Parliament-street, impts. in railway chairs, fastenings, and sleepers.

2183. William Rogers, of Newport, Monmouthshire, impts. in the construction of the permanent way of railways.

2185. George Washington Howard, of West Bloomfield, Michigan, U.S.A., impts. in tanks and other receptacles for containing and transporting petroleum, naphtha, and other oils and liquids, to prevent wasteage by fire or filtration, or evaporation, or hazard of life.

2187. Charles Adolphus Watkins, of Greek-street, Westminster, impts. in apparatus for supplying carbonic acid gas to casks and other vessels from which beer, wine, and other fermented liquors are drawn.

2189. William Edward Newton, of Chancery-lane, impts. in steam boilers or generators,—a communication.

2190. Alfred Vincent Newton, of Chancery-lane, impts. in the construction of skates,—a communication.

2191. John Moule, of Hackney-road, impt. in the treatment of tar and other substances suitable to be used in the manufacture of paint, and for other purposes.

The above bear date August 25th.

2192. Frederick Hazeldine, of Lant-street, Borough, impts. in the construction of vans, waggons, or carts employed for transporting furniture and other goods on common roads and railways.

2193. John Fulleck Hearsey, of Park-place, Church-street, Brompton, impd. construction of spirit meter,—a communication.

2194. James Alfred Wanklyn, of the City, impts. in the manufacture of violet dye stuffs.

2195. John Fordred, of Blackheath, impts. in the treatment of certain products obtained in the refining of petroleum, and of other hydro-carbon oils.

2197. John Symmons, of Wolverhampton, impts. in the manufacture of horse-shoes, and in machinery used in the said manufacture.

2198. Edmund Dorman Hodgson, of Paper-buildings, impts. in the manufacture of locks.

2199. Robert Gordon Rattray, of Aberdeen, impts. in apparatus for supplying regulated or measured quantities of water.

The above bear date August 26th.

2202. William Graham, of Bolton, John Broughton, of Manchester, and Thomas Corkhill, of Birkenhead, impts. in rotatory engines.

2206. Henri Adrien Bonneville, of Paris, impts. in dyeing and fixing colors in fibres, yarns, and fabrics,—a communication.

2207. Henri Adrien Bonneville, of Paris, impts. in apparatus for raising and holding the skirts of ladies' dresses,—a communication.

2209. Stopford Thomas Jones, of Oxford-terrace, Peckham, impts. in submarine electric-telegraph cables.

2211. Alfred Vincent Newton, of Chancery-lane, impd. apparatus for supplying boilers with water,—a communication.

2212. Edward Davies and Richard Hobbs Taunton, of Birmingham, impd. combination drill brace.

2213. Peter Piggott, of Argyll-street, Regent-street, impts. in electric telegraph cables, and in transmitting signals therethrough.

The above bear date August 28th.

2215. George Robinson, of Kingswinford, impts. in moulds for casting metallic pipes, retorts, and other articles.

2216. Adolf Gurlt, of Birmingham, impts. in condensing and utilizing sulphurous smokes and vapours, and in apparatus to be used for that purpose.

2220. William Henry Gummer, of

Rotherham, impd. stench-trap and sink-pipe protector.

2222. Isaac Bailey and William Henry Bailey, of Keighley, impts. in machinery for combing wool and other fibrous materials.

2223. William Clark, of Chancery-lane, impts. in apparatus for propelling vessels,—a communication.

2224. George Frederick White, of Hornsey, and Harvey Chamberlain, of Falcon-square, London, impts. in apparatus for elongating and contracting waist and other belts; which apparatus is also applicable for other purposes.

The above bear date August 29th.

2225. Thomas Cope, of William-street, Hampstead-road, and William Guest, of Rosoman-street, Clerkenwell, impts. in the manufacture of rope, cordage, yarn, wire rope, and other such like twisted and plaited fabrics, and in the machinery employed therein.

2229. William Crookes, of Wine Office-court, Fleet-street, impts. in extracting and separating gold and silver from their ores or matrices, and in the treatment of mercury employed for such purposes.

2230. Charles Francis Anderson, of Finchley, and David Durant, of Colney Hatch, impts. in apparatus applied to pockets, to ensure the safety of their contents.

2231. John Henry Johnson, of Lincoln's-inn-fields, impts. in tanning, and in the preparation of extracts to be used therein,—a communication.

2232. Thomas Wrigley and Marcus Brown Westhead, of Manchester, impd. method of retaining and preventing the vibration of sliding windows used in dwellings, and in railway and other vehicles; and for an improved apparatus for effecting the said purposes.

2233. William Henry Postlethwaite Gore, of Langham-street, Portland-place, impd. means of securing corks in the necks of bottles.

2235. Samuel Gilbert and Samuel Gilbert the younger, of Wansford, Northamptonshire, impd. implement for cultivating or tilling land.

2236. George Smith and Charles Ritchie, of Upper Thames-street, impts. in brushes.

The above bear date August 30th.

New Patents Sealed.

1865.

504. Godfrey Sinclair.
518. C. W. Lancaster.
524. John Shortridge.
525. C. J. Rowe.
531. E. P. H. Gondonin.
532. T. Routledge and T. Richardson.
533. J. H. Rawlins and J. Chappell.
537. John Askew.
541. Ralph Smith.
542. Charles Whiting.
547. Comyn Ching.
548. M. B. Nairn.
550. T. W. Roys and G. A. Lilliendahl.
551. Robert Barclay.
553. John Blackie, jun.
558. George Lauder.
559. J. M. Hart.
560. Arthur Davey.
562. W. B. Dalston.
566. J. Hartshorn and W. Redgate.
567. Sydney Whiting.
568. T. S. Smith.
572. G. H. Barth.
573. William Holiday.
577. John Dodd.
578. W. E. Kochs.
579. A. T. Godfrey.
580. T. Horton and D. S. Price.
581. James Park.
585. Samuel Chatwood.
589. Peter Rothwell.
591. Charles Rahn.
592. Robert Johnson.
597. D. Manwell and J. Manwell.
599. R. A. Brooman.
602. Luke Thomas.
608. Henry Taylor.
610. L. L. C. Cottam.
611. R. A. Brooman.
612. William Clulow.

622. S. Phillips and J. Groves.
624. Francis Cruickshank.
628. William Riddle.
633. E. W. Young.
634. R. A. Brooman.
635. J. H. Wilson.
636. Loftus Perkins.
637. A. E. A. Aubert and G. E. M. Gerrard.
638. William Clark.
639. William Clark.
642. Frederick Tolhausen.
648. John Shanks.
649. Morgan Morgans.
652. F. W. Turner.
659. William Clark.
660. J. T. Harris.
661. W. H. James.
662. R. G. Fisher.
663. W. J. Daning.
665. W. D. Allen.
666. Joseph Cliff.
668. G. F. Ansell.
669. Victor Delperdange.
670. J. Freeman, E. G. Freeman, and C. H. Freeman.
671. E. A. Phillips.
675. George Wright.
680. J. Samuel and S. Millbourn.
684. Charles Johnson.
687. Julius Garelly.
690. T. Whitehead and H. W. Whitehead.
692. E. B. Wilson.
693. J. M. Napier.
695. John Tann.
697. R. M. Roberts.
701. Robert Marsden.
702. Henry Hill.
705. Francis Wise.
708. F. A. Braendling.
709. James Deas.
710. George Evans.
711. R. A. Brooman.
712. R. A. Brooman.
714. E. D. Hodgson.
717. G. T. Bousfield.
718. Longin Gantert.
726. Henry Chevob.
729. A. P. Price.
730. J. F. Brinjes.
736. John Ramsbottom.
737. J. Farrar and E. Booth.
738. William Loeder.
740. Robert Bell.
741. William Brookes.
745. H. A. Bonneville.
748. Benjamin Lawrence.
750. James Bullough.
757. James McConnell.
758. Gerald Ralston.
759. E. Pilling and J. Harper.
761. Joseph Walls.
762. Thomas Kenyon, jun.
763. Francis Wise.
764. James Vero.
765. J. C. Stevenson.
768. J. H. Kidd and J. C. Mather.
772. J. T. Cook and J. T. Cook, jun.
774. Isidor Philippsthal.
777. R. T. Crawshay and J. A. Lewis.
778. Samuel Chatwood.
779. William Menelaus.
780. A. R. Mackenzie.
792. William Berry.
796. W. M. Williams.
797. Harold Potter.
810. William Clarke.
813. T. H. Saunders.
820. Henry Oakes.
824. G. H. Castree and J. A. Castree.
832. William Loeder.
848. E. H. Smith.
859. James Buckingham.
868. Joseph Williams.
890. Alexander Chaplin.
901. Archibald Turner.
912. H. A. Bonneville.
917. James Bathgate.
932. J. Von der Poppenburg.
943. C. D. Young.
952. William Clark.
953. Joseph Vaughan.
955. W. E. Newton.
980. George Davis.
1019. R. Fergusson and W. Ralston.
1031. W. E. Newton.
1048. George Jackson.
1050. W. E. Newton.
1104. David Greig.
1134. J. Howard and E. T. Bousfield.
1240. J. H. Johnson.
1282. R. H. Twedaell.
1325. G. Simmons and G. W. Simmons.
1392. W. E. Newton.
1494. Hypolite Monier.
1562. J. R. Cooper.
1592. James Hayes.
1623. G. E. Way.
1631. J. H. Johnson.
1646. George Smith.
1672. Samuel Godfrey.
1677. W. E. Newton.
1837. T. C. McKeen.
1844. G. C. Collier and C. L. Roberts.
1858. Samuel Hingley.
1885. George Nimmo.

**** For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S
London Journal of Arts and Sciences.

No. CXXXI. (NEW SERIES), November 1st, 1865.

ON THE USE AND ABUSE OF COAL IN OUR MANUFACTORIES.

But few people in this country can require to be told that any considerable improvement in the production or application of artificial heat, would constitute one of the most profitable inventions of the present day; consequently, we regard it as unnecessary to point out the importance of the subject now before us. To diminish, however, in some degree the difficulties connected with the elucidation of this subject, we will begin by endeavouring to separate the chemical from the mechanical part of our argument, so as to circumscribe or define the outline of those impediments that beset the question of perfect combustion. In burning coal we really burn two substances which differ greatly in their combustible qualities; that is to say, we burn hydrogen and carbon, the first of which will oxidise or burn under conditions that leave the latter unburnt. Then, again, we practically attempt to burn coal in oxygen gas diluted with nearly four times its bulk of nitrogen gas; that is to say, in atmospheric air. But the chemical impediments to perfect combustion created by such an attempt, amount to this: firstly, the hydrogen of the coal being more combustible than the carbon, has a disposition to seize upon the oxygen of the air, and leave the carbon unburnt; secondly, the nitrogen of the air, by diluting the effect of the oxygen, reduces the intensity of the heat given off by the hydrogen, so as to bring the temperature below that point at which the carbon from coal will burn; therefore, chemically speaking, a double tendency exists to leave the carbon of the coal unconsumed—a fact which we see daily exemplified by the formation of soot. There is, however, a much more serious question than the production of soot connected with the difficulties of perfect combustion, and this arises out of the disposition of red-hot carbon to decompose carbonic acid gas and convert it into carbonic oxide gas, with the absorption of an immense amount of caloric, or, in other words, with the generation of much cold. For example, if one pint of carbonic acid gas is subjected for a short time to the action of a quantity of red-hot coke, the gas is decomposed and converted into two pints of carbonic oxide gas, and during this process a vast amount of

heat is rendered latent or lost; so that it is practically possible for us to take two equal quantities of coke, and having burnt one of these, then to pass the resulting carbonic acid gas over the other portion of coke in such a manner as to absorb or render latent an amount of heat almost equal to the whole of the heat given off by the first portion of coke. To speak plainly, it is possible to burn coal so as to obtain little or no heat from its combustion, in consequence of the formation of carbonic oxide gas; and this circumstance we most earnestly wish to impress upon the attention of the public; for the production of unburnt coal or soot is a defect at once visible to the eye, and therefore calculated to attract the notice of every person; but the formation of an invisible gas like carbonic oxide, is a defect which may and does go on to an extent far beyond even the imagination of the most careful manufacturer, as we shall hereafter show by a reference to actual experiments. With regard to the mechanical difficulties connected with combustion, these are very much dependent upon the radiation and conduction of heat by the different substances employed in the construction of our furnaces and the steam-boilers placed over them. As, however, the principles of calorific radiation and conduction are almost totally unknown to the constructors of our furnaces, it need not surprise us to find that much of the heat produced by our fuel is lost or misapplied in the generation of steam. The radiation of heat takes place under such laws that its effect diminishes as the square of the distance: consequently, if a fire at the distance of one foot from a boiler is able to boil off 16 lbs. per minute of water by radiation, at a distance of two feet, it will boil off only 4 lbs., and at four feet but 1 lb. of water per minute.

In respect to the conduction of heat, it might at first sight appear that in this particular we are limited to the conducting powers of water and malleable iron; but a very slight examination of the practical working of the question soon teaches us that the conducting power of the iron is set at nought by the deposition of calcareous matter having a conducting power scarcely equal to $\frac{1}{50}$th of that possessed by iron. To render our remarks intelligible, we say that by actual experiment we have proved that if an iron boiler 1 inch thick will boil off 50 lbs. of water per minute, the same boiler having within it a calcareous crust 1 inch thick will boil off only about 1 lb. of water per minute, the heat applied to the exterior of the boiler being equal in both cases. Hence, then, we see that it is possible so to place a boiler as to lose by radiation fifteen parts out of sixteen of the heat applied to it; and again, it is possible, by permitting the incrustation of a boiler, so to diminish the conducting power of the iron as to lose forty-nine parts out of fifty of the heat applied to it. No doubt these extreme calculations; but what, after all, is the real condition of the It is this, that practically at this moment in our manufactories,

with a kind of coal capable of converting fifteen times its weight of water into steam, only 6 lbs. of steam are raised per lb. of coal consumed; in other words, more than one-half of the coal burnt under our steam boilers is thrown into the air and lost. Nor is this a hasty assertion, for it is based upon the daily working of several different steam boilers in London, Liverpool, Manchester, Newcastle-on-Tyne, and Glasgow.

Having thus far pointed out the impediments which chemically and mechanically interfere with the production and application of the heat from coal, we will now relate what we ourselves have done within the last two years by way of removing these impediments. To ascertain the extent of the loss created by imperfect combustion in our furnaces, it became necessary to examine the composition of the air passing from the chimney. Of course we had no difficulty in collecting a portion of this air, which was then analysed in the following manner:—From a measured quantity of it, the carbonic acid was abstracted by a solution of caustic potash; the oxygen was then removed by adding a little pyro-gallic acid to the potash solution: this solution was then poured out and replaced by a solution of the proto-chloride of copper in muriatic acid, so as to absorb the carbonic oxide, after which, in some cases, the remaining air or gas was passed over red hot oxide of copper contained in a glass tube, with a view to discover the quantity of hydrogen contained in it. It might have been anticipated that the results from different chimneys and at different periods of the charge of fuel would have been exceedingly various and contradictory; but although not absolutely uniform, our results present a general agreement in the most important features that cannot be regarded as otherwise than satisfactory so far as the object of our inquiry is concerned. After making upwards of 370 experiments upon the air from 42 different chimneys, we have come to this general conclusion—that, except immediately after a charge of coal, the air from a *well*-fed furnace contains no appreciable amount of hydrogen or hydro-carbon, or sulphurous acid; that the quantity of carbonic acid gas is about 6 per cent., the quantity of oxygen gas about 9 per cent., and the quantity of carbonic oxide gas about 8 per cent., thus leaving us to infer that about 9 per cent. of the oxygen in atmospheric air is consumed by the hydrogen of the coal. Hence it appears, that in respect to the production of heat in furnaces, 9 parts of the oxygen of the air escape unacted on; and of the remaining 12 parts 6 are converted into carbonic acid, 2 combine with the hydrogen to form water, and 4 are carried off in the shape of carbonic oxide gas. Consequently, we may say that out of every 12 degrees of heat which ought to be produced by our fuel 4 degrees are directly abstracted by the generation of carbonic oxide gas, and probably not less than 1 degree in addition is absorbed by the gas, and rendered latent; there

fore it is evident by the analysis of the air from our furnace chimneys, that $\frac{5}{12}$ths of the fuel consumed upon the furnace bars is lost as carbonic oxide, and thrown uselessly out at the chimney. But we have seen that practically, in the generation of steam, only $\frac{6}{15}$ths of the total calorific power of the coal is employed or absorbed by the steam produced; and if we allow $\frac{1}{15}$th of this calorific power as a necessary means for creating a draught in the chimney, we shall still have $\frac{8}{15}$ths unemployed or lost: consequently, in a practical point of view, it appears that heat is carried off otherwise than by the action of the carbonic oxide gas. To render the amount of this loss intelligible, we must reduce our fractions to a common denominator: that is $\frac{5}{12}$ to $\frac{75}{180}$ and $\frac{8}{15}$ to $\frac{96}{180}$, from which we see that $\frac{21}{180}$ths of the heat are lost by radiation and imperfect conduction. If, then, we assume that any given quantity of coal, when burnt in our steam-boiler furnaces, will give out 180 degrees of heat, that heat will be thus distributed:—

Usefully employed in raising steam	.. ..	84 degrees.
Lost from carbonic oxide gas	.. ..	75 „
Lost from radiation and imperfect conduction	..	21 „
Total..	.. ..	180

Merely to point out an imperfection is, after all, but a very sorry qualification, and therefore we have tried to go a little farther; we have tried to improve our steam-boiler furnaces, and apparently with some success. Many years ago Dr. Kennedy asserted that the hottest part of a furnace is one inch above the bars, and this is true with furnaces having a slow draught; but with a quick draught it is otherwise; and from pyrometrical experiments made in boiler furnaces, we have found that the hottest point is between two and three inches above the bars of the furnace: consequently, we recommend that never more than four nor less than two inches in depth of fuel be upon the bars of a steam-boiler furnace in action. If less than two inches be upon the bars, much useless air will pass through the fuel, and carry off the heat; if more than four inches be upon the bars, great part of the carbonic acid produced near the bottom of the fuel will be decomposed near the top, and converted into carbonic oxide gas with the destruction or absorption of a vast amount of heat, thus rendered latent. From what we have stated in regard to the radiation of heat, it is clear that the boiler ought to be placed as near to the fire as possible, and by so doing this additional advantage is gained: it prevents a lazy stoker from overcharging his furnace bars and thus producing an extra amount of carbonic oxide. Great stress is laid by some stokers upon the burning away of the boiler in consequence of this close proximity of the fire: it is not, however, the nearness of the fire, but the thickness of the internal crustation, which causes the burning away of the boiler; and this we will hereafte

explain. At present, we return to the question of combustion. From our analyses of the air in the chimneys, it is evident that sufficient oxygen exists in it to convert the carbonic oxide into carbonic acid, or, in other words, to completely burn the whole of the fuel: why, then, is the carbonic oxide not burnt? This arises from two causes: the positively anti-inflammatory nature of carbonic acid gas, and the cooling influence of the nitrogen gas and steam boiler, by which the temperature of the mixed air is cooled below that point at which carbonic oxide gas will take fire and burn. Now, although we cannot alter the positive power of the carbonic acid, we may overcome the cooling influence of the other agents; and this has been most successfully effected in the following manner:—A cast-iron tube, 4 inches in diameter, was fixed in the lower part of the chimney and made to communicate with the external air by means of a bend, at a height of 6 feet from the ground; to the lower end of this tube a similar tube was fixed, and this was made to pass horizontally under the boiler about 1 inch from it. The horizontal part of the tube terminated immediately over the back of the furnace and was joined to the middle of a cross-piece of similar tubing; the cross-piece being as long as the width of the furnace and closed at the ends, but pierced all along with a number of ⅛-inch holes at the distance of 2 inches from each other. The theory of the action of this tube is very simple: from its position it becomes heated throughout its whole length, and the cross-piece in particular becomes red-hot; the draught of the furnace causes the air to enter at the bend or open end, and traversing the tube this air issues in a red-hot state from the holes in the cross-piece, where it meets and burns the carbonic oxide gas as fast as this is generated by the fuel. The result is, that in four steam boilers where this contrivance has been applied, the steam is generated much more readily than usual, and a manifest economy of coal is taking place.* It is necessary, however, for us to remark, that another expedient has also been adopted in the case of the same boilers: this relates to the prevention of incrustation. A few careful analyses had convinced us that this incrustation is not due to carbonate of lime, but to sulphate of lime, by which the particles of carbonate of lime are cemented together and converted into a crust. To prevent the formation of this crust, it is necessary only to destroy the sulphate of lime, which is easily done by adding 1 lb. of common carbonate of soda (washerwoman's soda) to every 300 gallons of water supplied to the boiler. This converts the whole of the lime into carbonate, which has no tendency to agglutinate, but remain as

* Our contributor is probably aware, in common with many of our readers, that the principle of introducing air at or near the bridge of the furnace is not new, as witness the several plans shown in Plate IX., Vol. I., *Lon. Jour.*, *New Series*,—viz., Frankhams's, Garland and Glasson's, Woodcock's, and Robertson's; but none of these plans appear to us calculated to effect the object which he contemplat —Ed. Lon. Jour.

a semi-crystalline powder, that may either be collected by placing an empty vessel in the boiler, or it may be blown out at intervals in the form of milky fluid. In both cases the conducting power of the iron boiler is preserved, which not only facilitates the development of steam, but prevents the burning or oxidisement of the boiler. That it must also prevent or diminish the number of explosions is more than probable.

LEWIS THOMPSON, M.R.C.S.

THE AMERICAN TORPEDOS AT CHATHAM.

THE recent American war, which has been carried on with all the appliances of science known to a people both quick to invent and ready to employ any and all the contrivances that promise success, has, as might have been expected, brought out some facts which the nations of Europe cannot afford to neglect. Not the least important of these is the practicability of introducing torpedos into naval warfare, both as instruments of attack and defence. It is not, perhaps, generally known, but it is nevertheless true, that the skill which the Federals acquired in the use of these formidable weapons was the main cause of the sudden opening of the long beleaguered city of Richmond to their forces.

During the Russian war, it will be remembered that the Baltic Sea was carefully studded with torpedos, constructed under the personal superintendence of a learned professor, whose design was to make them float below the surface of the water, and explode either by percussion on the grating of a British hull against them, or by applying to them an electric current. So little, however, were Professor Jacobi's torpedos calculated to protect the Russian ports and roadsteads from molestation, that they served as sport for our sailors, who fished them up with facility, and examined them with about the same feeling that the discovery of a new species of fish would call forth. Throughout the war, if we remember rightly, the whole damage effected by the Russian torpedos was the total destruction of the dinner service of a British frigate, which struck against one of these hidden enemies, and the singeing of the whiskers of a too-curious group assembled on the deck of another of our cruisers to inspect the structure of one of these sea monsters, which exploded under the rough treatment it received at their hands. Very different in destructive energy must have been the torpedos which the Confederates used throughout the war with such fatal effect to the Federal navy, but it does not appear that their torpedos ever approached to the certainty of action claimed for those of the Northern States.

Of the facility which the Federals attained in firing torpedos, and of their destructive effects, we recently had a practical proof in the Medway, at the entrance to Chatham harbour, when Mr. Beardslee, the inventor of an improved fuse for torpedos, and to whom the submarine operations of the Federal Government were entrusted throughout the latter part of the war, demonstrated to the Lords of the Admiralty the feasibility of closing the Thames, or any other river, against the approach of hostile armament without indicating the presence of defensive preparations. No one who witnessed this exhibition, which came off on the 4th October, and which had been prepared at the Chatham Arsenal under the superintendence of Mr. Beardslee, will readily forget it. The programme seemed to be, first to show the effects produced by exploding torpedos upon the water in which they were immerged. Secondly, to give a practical test of their action upon vessels afloat. For the latter purpose the Admiralty had placed at Mr. Beardslee's disposal the hull of the 18-gun sloop "Terpsichore," the blowing up of which was to be the crowning feat of the day. Fortunately for sight-seers, and for vessels passing up and down the Medway, the day was bright, and the operations could be distinctly seen from the Chatham heights, as well as at a safe distance on the water. The torpedos used, according to the *Times*' report, were of two kinds—"the one called electrical buoyants, and the other percussion. They were, in both cases, formed of hollow water-tight cylinders, made of wrought iron, and varied in size and power. The largest were constructed to receive a charge of 400 lbs. of powder, and the smallest for a charge of 68 lbs.; the former being some 9 feet or 10 feet long, and 1 foot in diameter, while the latter were not above a third of that length." The buoyancy of the torpedos was obtained by attaching to each a cylindrical float by means of a rope, which could be lengthened or shortened to adjust the torpedo to the proper depth in the water. Before the experiment on the vessel came off, we witnessed from a distance the effects upon the water of three explosions. At the first a great breadth of water was upheaved, having the appearance of a huge iceberg, of a jagged pyramidical form. This form was maintained for an appreciable time, until it seemed to fade away rather than sink out of sight. The second explosion sent the water up in the form of a huge crag, with vertical sides, and immediately after a low, dull report was heard. The outline of the crag was maintained for perhaps half a minute, and it gradually faded away like a dissolving view, leaving the conviction that had this upheaval taken place beneath a ship's boat it would have lifted it into mid-air. The third explosion was accompanied by a faint report and the upheaval of the water in the form of a column, which, as it faded away, left a vapour which overhung the river for some time after the column had disappeared.

The great event, the blowing up of the "Terpsichore," upon which the whole interest of the spectators was concentrated, proved to the uninitiated a total failure. When, after long preparations, and the flitting about of the Admiralty row-boat around the devoted vessel, a dull report was heard, and the water was seen to dash up one side and over the bulwarks of the vessel, the experiment was unanimously pronounced a failure, but in a minute or so the Terpsichore was seen to be "settling forwards," and shortly afterwards it was evident to all that she had grounded in low water. An illustration given in the *Illustrated London News*, from a sketch taken of the vessel since she was raised and docked, shows that one of her bows had been driven in, making a large entrance for the water, but forming no detached splinters. So much for the effect of a 75-lb. torpedo, placed at some seven feet below the keel of the vessel.

The chief, if not the only, novelty in the torpedos used on this occasion was the fuse, which, from its peculiar construction, insures the firing of a charge by means of a current of electricity from a battery or electro-magnetic instrument. It is well known that, in order to ignite powder by this means, the current must be intensified at the point where the metallic conductor, through which the current travels, is in contact with the powder to be fired. This has been heretofore effected by introducing into the current fine wire or foil, which is raised to a red heat by the passage of the current through it. Or the Ruhmkorff coil has been used, whereby an electric spark may be caused to leap from the point of one conductor to another, and in its passage fire the charge. These, however, have in practice proved defective from various causes, and Mr. Beardslee, in lieu thereof, merely connects the ends of the conducting wires of his fuse, which are fixed in a wooden block or holder, by means of a line of plumbago marked on the end of the block with a soft lead pencil, which mark forms a feeble conductor of electricity. "When, therefore," to use his own description, "a current of electricity is induced, in passing through the plumbago mark, it will ignite a portion of the metal mark, and produce a 'break' with an intense flash, which will ignite the contained charge of powder." The result which he has obtained by this simple device is to insure the instant discharge of these formidable instruments of warfare, and that either singly or in groups, so that no artificial obstacles placed in his way, such as those which so long defied the efforts of the Federals to approach Richmond by water, could withstand the power he is able to apply to their destruction. Does this invention bode good or evil to the world? It is a tough question for the humanitarians to solve.

Recent Patents.

To Andrew Barclay, *of Kilmarnock, Ayrshire, for improvements in certain apparatus for injecting and ejecting fluids.*—[Dated 6th May, 1864.]

This invention consists chiefly in extending the annular nozzle, used in instruments for injecting liquids, through which the liquid passes, to a much greater length than has hitherto been accomplished; also, in forming an annular passage beyond the first-mentioned nozzle, for the purpose of obtaining an annular sheet of steam or water after the stream has passed through this nozzle; by which arrangement a far superior force, both for raising and also for forcing fluids generally, is obtained.

Another improvement involves the forming of a tapered or conical condenser, into which steam or other condensible vapour is admitted, in such quantity as may be required for the purpose of injecting or ejecting fluids. In this arrangement the fluids, either injected or ejected, have imparted to them the momentum of the fluid, moving with the velocity of the vapour used rushing into a vacuum. In this apparatus the condensation may be effected in any of the modes generally used for condensing steam or other vapours.

The apparatus consists essentially of a hollow truncated cone, terminating in a nozzle placed inside a hollow cylindrical vessel, in which vessel the condensing fluid is admitted, so that it condenses the injecting or ejecting fluid or vapour, thereby producing a partial vacuum in the conical chamber. The fluid to be injected or ejected is admitted through a suitable pipe or duct connected to and passing through the side of the outer vessel into the conical one, whence it is injected or ejected through the nozzle at its extremity, passing thence to any place where it may be required.

In Plate IX., fig. 1 is a vertical section of the improved apparatus. The steam enters by the branch pipe A; the water or other fluid to be raised enters by the branch pipe B; and the overflow is formed by the branch pipe C, cast on the lower part of the apparatus, as also the flange D, which flange forms the connection to the boiler or other receiver through which the fluid to be injected passes. The steam nozzle E, is screwed into one end of the adjustable cylinder F, and is surrounded by an envelope or casing G, leaving a free space between the outside of the nozzle E, and its casing G; this space may be filled with any non-conducting substance, or it may only contain the air enclosed in putting on the casing. The object of surrounding the steam nozzle with any non-conductor of heat, is to maintain a high temperature of the steam until it reaches the exit from its nozzle E, as priming is very injurious whilst forming the vacuum. The water or second nozzle H, in this modification is extended to a considerable distance beyond the first or steam nozzle E, and becomes of an annular form by the introduction of the centre adjustable spindle I. This spindle I, by reason of its tapered form, when raised or lowered by turning the hand wheel J, increases or diminishes the annular space, to suit the pressure of steam employed, and the height from which the water or other fluid has to be raised. At a short distance from the aforesaid nozzle H, a receiving nozzle or throat K, is so placed and

adjusted by means of a self-acting valve L, that when a greater or less quantity of fluid is discharged from the second nozzle H, the throat accommodates itself accordingly. The adjustable cylinder F, may be raised or lowered by turning the hand wheel M, through the introduction of a screw formed on itself, working in a nut formed in the upper part of the apparatus, as shown at N, or any other convenient appliance to obtain a similar effect—that is, the raising and lowering of the cylinder to suit the desired quantity of fluid to be injected. A series of holes or slots is formed opposite the steam branch A, through which the steam passes to the interior of the cylinder F, as indicated by the arrow at O. To maintain a perfectly air-tight packing between the steam-branch A, and the nozzle chamber P, hemp or other elastic substance is forced into the space Q, between the adjustable cylinder F, and the body of the apparatus, by means of a gland R; the cylindrical part of which, within the body of the apparatus, and where it passes the steam branch A, has a series of holes or slots to admit of a free passage of the steam to the interior of the adjustable cylinder F. When water or other liquid has to be raised about 20 or 25 feet, it is very necessary that the lower packing Q, should be perfectly air-tight, and this can be accomplished at any time by screwing up the gland R. To prevent any passage or leak of steam within and around the gland R, two small stuffing boxes with glands S, and T, at right angles to each other, are screwed up by means of bolts or studs when required. The adjustable spindle I, is kept steam-tight by the stuffing-box U.

The action of the apparatus may be described as follows:—On steam being admitted by the branch pipe A, it issues at the nozzle E, and on meeting the angle of the second nozzle H, it is deflected towards the centre spindle I, which again deflects it towards the nozzle H, in a zig-zag form, as indicated by the dotted lines. This zig-zag wave motion expels the air from the nozzle chamber P; and the steam, forming, as it were, an annular fluid piston, prevents any return through the nozzle H. So soon as the vacuum is sufficient to raise the water or other fluid to be injected, it rushes in through the branch pipe B, and is expelled by the steam through the second nozzle H, the water and steam together now forming the fluid piston in the nozzle H. The water as yet may not have sufficient force to pass through the throat K; it therefore gets an outlet by the overflow passage C. On turning the hand wheels J, and M, so as to give both more water and steam, the force imparted to the water becomes sufficient to pass through the throat K, and enter the boiler or other receiver. In starting the apparatus, it is essential that the steam nozzle E, should be close to the second nozzle H, when the water has to be raised from a great depth, such as 25 feet, but otherwise the setting or adjusting of the apparatus is very similar to those now in use.

A modification of packing the adjustable cylinder F, is represented in fig. 2. In this arrangement one gland R, serves to screw up both the packings Q, and Q[1], and by merely using a loose ring or cylinder between the two packings, one gland R, serves to maintain the adjustable cylinder F, perfectly steam and air-tight. Around the loose ring or cylinder V, and through it, are a series of holes or slots opposite the steam branch A, to admit of the steam passing to the interior of the adjustable cylinder; in other respects this modification is similar to

that already described. Instead of admitting the steam by the branch pipe A, and the water by the branch pipe B, they may be reversed, as shown in fig. 3, where B, is the steam branch, and A, the water branch. In this modification the steam for the first impulse strikes against the centre spindle I, and is deflected towards the nozzle H, as shown by the dotted lines; otherwise the action and construction of the apparatus are similar to those just described. The water passing through the nozzle E, is expelled through the nozzle H, by the surrounding ring of steam, and gains sufficient force to pass through the throat K, into the receiver, where water or other fluids are required.

It will be observed, from the foregoing description, that water may be raised from a great depth and fed into a steam boiler or other receiver direct by the afore-mentioned apparatus.

At fig. 4 is shown, in vertical section, another modification of the improved apparatus for injecting or ejecting fluids, which arrangement is considered to be one of the most important features of the invention. The outer casing of the instrument has formed on it two water branches A, and A^1, and one steam branch B. Immediately on the inside of this outer casing there is fitted the gland C, which presses upon the packing D, this pressure being continued further on to the next ring of packing D^1, by the introduction of the slotted metallic collar E, the slots formed in which are for the purpose of enabling the water admitted through or at the branch A, to be carried in towards the central part of the instrument. Beneath the second ring of packing D^1, there is placed another similarly formed metallic ring E^1, with slots also formed in it, to enable the steam to be condensed into the annular steam space F, of the apparatus, and this in turn acts or presses upon the lowest ring of packing D^2, the several rings of packing D, D^1, and D^2, forming a suitable bed, in which the barrel G, is capable of sliding, to be adjusted as may be required. The barrel G, it will be observed, forms the outer shell of the annular steam space. Inside the barrel G, is fitted the gland H, bearing upon the ring of packing I; this again bears upon the slotted metallic ring J, below which is situated another ring of packing I^1. These two rings of packing I, and I^1, form suitable beds, within which the barrel K, forming the inner annular water space L, is capable of being adjusted with respect to the barrel G. Inside the barrel K, there is situated the adjustable spindle M. Both the spindle M, and the barrel K, are actuated by the hand wheels N, and N^1, in a similar way to that described in reference to figs. 1 and 2. On more particularly referring to fig. 4, it will be observed that both of the barrels G, and K, are mounted at their lower ends with nozzles O, and O^1, within which is contained the non-conducting substance, or it may be an air-tight space, shown in black.

It has been mentioned that there are two water inlets or branches A, and A^1, in this arrangement, in lieu of one; whilst there is only one inlet for steam. These two water branches A, and A^1, are in direct communication with the two annular nozzles. When it is desired to feed a fluid of a somewhat elevated temperature, the warmed fluid is admitted through the branch A, whence it travels or passes onwards to the central water space L; but since the principle of the apparatus, and its effectual working, are chiefly dependent upon the formation of a vacuum produced by the condensation of steam admitted at the

branch B, it is obvious that if the injected or ejected fluid be of a very elevated temperature, it will act detrimentally upon the working of the instrument by preventing so perfect a vacuum from being formed. To counteract the production of this effect, and to secure the very effectual working of the instrument prior to the admission of the heated fluid, a colder fluid, or one possessed of a temperature sufficiently low to ensure the action being effective, is first admitted through the branch A^1, and this coming in contact with the steam jet, causes the latter to be speedily condensed; when the cold water is impelled forward with a velocity corresponding to that of the pressure of steam used, rushing from an orifice into the atmosphere,—the impelled water having a momentum equivalent to its own weight multiplied by the velocity of the flow of the steam or other impelling fluid. So soon as the action of the instrument is insured by the admission of the cold water and steam, then the heated liquid is admitted, and it is, as it were, pulled forward through the nozzle by the rushing action of the colder fluid.

A slight but important modification of this last-described apparatus may be effected by forming it without the water branch A, and substituting in lieu of it a port or duct C^1, shown in dotted lines, extending upwards on the exterior portion of the instrument in direct connection with a passage or communication with the slotted rings E, and J, through which the fluid passes into the inner water space of the instrument. It must be borne in mind that when the instrument is formed in this last-mentioned manner, it is to be used for injecting or ejecting a fluid of a comparatively low temperature, in which case there will be formed at the nozzle two annular jets of the injected or ejected fluid with an annular jet of steam situated concentrically between them, or, instead of this, two jets of steam with a jet of water intervening; and these arrangements effect a much more perfect condensation of the steam than when only a single jet of water is employed, as in the former modification, thus producing a more perfect action of the instrument. It will be observed that the central spindle is extended, so as to diminish the area of the injecting nozzle H. The screw U, is for the purpose of adjusting the position of the outer barrel K. This screw is capable of revolving easily in the upper part of the outer casing of the instrument; the screwed portion of it fits into a corresponding hole in the bracket formed on the side of the barrel K, and it is actuated by means of a winch handle or screw key made to fit on its upper end.

Another form of injecting or ejecting apparatus is shown in vertical section at fig. 5, which consists simply of an outer casing A, into which a current of cold water or other fluid of low temperature is admitted by the branch B, and out of which it flows by the duct C. The use of these two branches B, and C, is to provide a continuous flow of cold fluid around the conical nozzle D, into which steam is admitted and condensed. When the condensation has taken place, a continuous rush of steam from the source of that fluid impinges upon the condensed portion, and causes it to be emitted from the nozzle with a momentum corresponding to the amount of condensed steam multiplied into the velocity with which the steam itself would rush into a vacuum.

Fig. 6 is a modification of this last-named apparatus, in which the

whole or a portion of the condensing fluid is ejected, as well as the condensed fluid itself; this result being effected by making the nozzle to terminate a short distance within the vessel containing the condensing fluid.

The patentee claims, "First,—the general construction and arrangement of apparatus with an extended annular nozzle or nozzles for raising and forcing fluids generally, as described. Second,—the extension of the central spindle of the instrument into the injecting nozzle, so as to form an annular space therein, as well as to enlarge or diminish the area of that space in the manner described. Third,—the use and application of an extended annular nozzle for raising and forcing water or other liquid into steam boilers direct, as described. Fourth,—the use of a fixed casing containing any non-conducting substance between the steam and water nozzles, for the purpose and in the manner described. Fifth,—the use of an adjustable air-tight packing between the steam and water inlets, as hereinbefore described. Sixth,—the general arrangement and construction of apparatus for injecting or ejecting fluids, in which two barrels are employed to form annular jets of water and steam, which may be either two jets of water with a jet of steam between them, or two jets of steam with a jet of water intervening, as described. Seventh,—the arrangement and construction of apparatus for either injecting or ejecting a fluid of elevated temperature in combination with a colder fluid, as described. Eighth,—the system or mode of injecting or ejecting fluids of different temperatures in immediate contact with the steam nozzle, as described. Ninth,—the arrangement and construction of apparatus for injecting and ejecting the condensed fluid without its being in contact with the condensing fluid, as described."

To ALEXANDER PARKES, *of Birmingham, for improvements in manufacturing compounds of gun cotton and other vegetable substances similarly prepared, also in the preparation of castor and cotton oils and gum ballata, to be used with or separate from such compounds.*—[Dated 28th October, 1864.]

IN manufacturing compounds of gun cotton, the patentee employs a solvent prepared by distilling wood naphtha with chloride of calcium. To a gallon of wood naphtha from two to six pounds of fused chloride of calcium are added. The greater the quantity of chloride employed within these limits, the stronger will be the solvent produced. The mixture is distilled, and for use as a solvent the first three quarts which pass over are collected; the remainder may be received into a separate receiver so long as any spirit comes over, and distilled over again at the next operation, together with other naphtha and more fused chloride of calcium. What remains in the still is chloride of calcium dissolved in water with tarry matter; it may be run out into an open iron vessel heated by a fire beneath to evaporate off the water and fuse the chloride of calcium, so as to prepare it for another operation. The solvent thus prepared is added to the gun cotton usually in such a proportion as to produce with it a pasty mass, which is used for waterproofing or coating fabrics, making sheets, tubes, and other articles, and for insulating telegraph wires. The gun cotton compound, if used alone, would, however, become too hard and brittle to

be usefully employed for many purposes. To avoid this, it is kneaded with castor oil in a mixing machine, or, it may be, other similar oil, such as cotton seed oil, and used in proportions varying according to the degree of toughness and flexibility desired to be obtained. In some cases as much castor oil is used as one-half the weight of the gun cotton compound. Such a mixture is suitable for covering telegraphic wires where very great toughness and flexibility are required, and it can be applied with dies in the same manner as gutta-percha. The same mixture is also suitable to be spread upon fabrics, for waterproofing them. The spreading may be done by means of rollers. For some descriptions of articles, five per cent. of shellac, copal, or animi may be added, to increase the hardness of the compound, and modify the colour. In place of preparing the solvent with wood naphtha, it may be similarly prepared with alcohol; chloride of zinc and chloride of manganese may be substituted for chloride of calcium; they should be fused or dry. For the sake of economy, a small quantity of the light spirits from coal or mineral naphtha may be mixed with the solvent. In place of gun cotton, properly so called, other vegetable substances, similarly prepared, may be employed, and so in each case where the use of gun cotton is directed.

To check the combustibility of the compounds, either chloride of zinc or tungstate of soda may be mixed therewith; ten per cent. of either of these salts effectually prevents the burning of the compound, but much less will frequently give sufficient protection, especially when pigments are mixed with the compounds to colour them, as the pigments act more or less in the same way. Gelatine dissolved in glacial acetic acid may also be usefully combined with dissolved gun cotton, to check its inflammability.

The patentee also combines dissolved gun cotton with oil which has been treated with chloride of sulphur, to produce a more elastic composition than that obtained by mixing the dissolved gun cotton with unprepared oil. The oil preferred is castor oil, but cotton seed and linseed oils may also be used. From 2 to 10 per cent. of liquid chloride of sulphur, according to the degree of elasticity required, is mixed with the oil, the chloride being first diluted with an equal bulk or more of mineral naphtha or bisulphide of carbon, to prevent too violent an action. This prepared oil is compounded with the dissolved gun cotton in proportions varying with the degree of elasticity required, but it seldom exceeds 20 per cent. Cotton seed and castor oils, treated with chloride of sulphur as above described, may be employed alone or without admixture of dissolved gun cotton.

The patentee also treats gum ballata with chloride of sulphur in the same way, but usually with not more than 5 per cent. of the chloride, and he compounds the prepared gum with dissolved gun cotton in the same way as the prepared oil is compounded. Gum ballata, thus prepared, may also be used without admixture with dissolved gun cotton.

The several compounds above mentioned containing dissolved gun cotton, are all similar in their properties to the compounds now well known as Parkesine. In working them, they are usually kept plastic by heat, and may be moulded through dies, or worked by rollers, or with moulds. If made sufficiently thin, the compositions may be cast in moulds, and also applied to surfaces with a brush or otherwise.

To Henry Alfred Jowett, *of Hayes, Middlesex,* John Eaton Jowett, *of Sawlay, Derbyshire, and* John Bell Muschamp, *of Pembroke-road, Kensington, for improvements in the construction of rails, and bearers for the same, for the permanent way of railways,*—[Dated 28th October, 1864.]

This invention consists chiefly in forming the rails with a rectangular groove upon the sides, running from end to end, and in securing the rails in position by the use of plates or bearers, one edge of which is inserted into the grooves, the other edge being secured to the sleepers, thereby dispensing with the use of the ordinary chairs and keys; and also in the mode of uniting the adjacent ends of the rails.

In Plate X., fig. 1 is a section of a rail, showing the method of securing it to the sleepers; figs. 2 and 3 show a method of coupling or fishing the rails. The width of the faces or running surfaces of the flanges or heads *a*, of the improved rail is about the same as that of an ordinary double-headed rail, but in place of a wide web, the rail is formed by the ordinary rolling mill with a web *b*, about one inch in width. The inner sides of the flanges or heads *a*, are made at right angles to the web *b*, forming therewith a rectangular groove or channel *c*, running from end to end of the rail on each side. The rails thus shaped are secured to the sleepers *d*, by inserting one edge of the plates or bearers *e*, into the grooves *c*, and bolting or otherwise fixing the other edge of the plates to the sleepers, as shown in fig. 1. A groove *f*, is formed in the sleepers *d*, to admit the lower flange or heads *a*, of the rails, which comes nearly in contact with the bottom of the groove, and may, if found desirable, rest thereupon, and be partially or entirely supported thereby. This groove is formed in the direction of the length of the rail, but either in the direction of the length or width of the sleepers accordingly as transverse or longitudinal sleepers are employed. The plates or bearers *e*, are inserted in the grooves *c*, on both sides of the rail, at suitable and convenient distances apart, which generally correspond in practice with the distance between the sleepers *d*, when transverse sleepers are used. Similar plates may be employed for coupling or fishing the rails, but they are advantageously made longer than required at other parts of the rail. When the bearers or plates *e*, are used for this purpose, they are inserted in the grooves *c*, at the joints, and extend an equal distance along the adjacent ends of the rails, being bolted or otherwise firmly fixed to the sleepers *d*. This method of coupling or fishing the rails is only practicable when the adjacent ends thereof meet over the sleeper.

Another method, illustrated in figs. 2 and 3, is employed when the ends of the rails are not directly supported by a sleeper, and may advantageously be employed when such support is given. Two square metal bars *g*, are employed as fish-plates. These bars are placed in the grooves *c*, at the joint, and extend an equal distance along the adjacent ends of the rails, and are of sufficient thickness to completely fill the grooves. The bars *g*, may be secured to the rails by means of screw bolts *h*, with hook-formed heads, as shown in fig. 2, or in any other suitable and convenient manner, the object being to firmly connect the two bars *g*. Should it be deemed undesirable to groove or channel the transverse or longitudinal sleepers, angle-iron bearers of a Z shape, and

of such a size that the inner edge may fit the grooves *c*, may be employed, the outer edge being bolted or otherwise secured to the sleepers *d*. When this method is adopted, the lower flange or head *a*, may either rest on the sleeper or the rail may be suspended on the angle bearers.

The patentees claim, "First,—the rail formed of two heads or flanges *a*, *a*, with rectangular grooves or channels *c*, substantially as and for the purposes specified. Secondly,—securing the rail in position by the employment of the rail bearers or plates *e*, substantially as specified. Thirdly,—coupling or fishing the rails by means of the bars *g*, substantially as specified."

To MARTYN JOHN ROBERTS, *of Pendarren, near Crickhowell, Brecon, for improvements in machinery or apparatus for sprinkling liquids over wool, cloth, and other substances.*—[Dated 5th November, 1864.]

THIS invention consists, first, in the use of a reservoir for oil or other liquid in which an apparatus revolves for the purpose of mixing the liquid, while at the same time it raises that liquid high enough to reach a sprinkling or scattering disc or apparatus, and also simply raising the liquid to the height named without mixing it as in the case of oil alone. Second,—raising the liquid high enough to enable that portion of it that is not thrown upon the wool or other material to return, by its own gravity, into the reservoir. Third,—the revolving apparatus, as hereafter described, for the purpose of scattering liquids. Fourth,—the returning the spare liquid into the main reservoir. Fifth,—the use of a partition for protecting the liquid returning into the reservoirs from being obstructed by the undulations caused by the revolving blades. Sixth,—the application of the apparatus hereafter described to the sprinkling of liquid over textile bodies and all other substances whatsoever; for example, linen in laundries, cloth, and wool.

In Plate IX., fig. 1 is a transverse section of an apparatus for sprinkling liquids arranged according to this invention. *a*, is a reservoir for the liquid to be sprinkled. *b*, is a shaft passing through the reservoir *a*, and carrying arms *c*, with blades *d*, attached thereto. *e*. is a trough or gutter into which some of the liquid raised by the blades *d*, in the revolution of the shaft *b*, falls. *f*, is a stop-cock communicating between the gutter *e*, and a pipe *g*, which revolves within the mouth of the stop-cock. *h*, is a hollow disc perforated on its periphery, and fixed to the pipe *g*, with which it communicates internally. This disc is furnished with a shaft *i*, and pulley *k*, round which a band or belt is passed, whereby the pulley and disc are caused to revolve rapidly. *l*, is a pan or small reservoir below the disc *h*, formed with a slot or opening *m*; ribs or combings *n*, are formed round this opening to prevent the liquid not sprinkled by the disc through the slot from falling through the opening on to the wool or other substance below. The disc *h*, and pan *l*, are fitted with a cover to catch any liquid thrown upwards by the disc *h*. *o*, is a pipe leading from the pan *l*, to the reservoir *a*, to return the liquid caught by the pan and by the roof to the reservoir. The action of the apparatus is as follows:—The wool or other material over which the liquid is to be sprinkled is caused to

travel under the opening in the pan *l*. The liquid in the reservoir *a*, is raised by the blades *d*, into the gutter *e*, and passes through the cock *f*, and pipe *g*, into the hollow disc *h*, which, by the rapid revolution imparted to it, throws out the liquid in a state of fine spray through the perforations in its periphery; some of this liquid spray passes through the opening *m*, on to, and sprinkles, the wool or other material below, while the rest of the liquid is caught by the roof and the pan *l*, and returned by the pipe *o*, into the reservoir *a*.

The patentee claims, "the machinery or apparatus for sprinkling liquids over wool, cloth, and other substances, arranged and acting substantially as described."

To George Haseltine, *of Southampton-buildings, for a new mode of fastening rivets, screw seats, or other similar devices in metallic plates, and also of securing thereby copper sheathing upon iron vessels,—being a communication.*—[Dated 5th November, 1864.]

This invention consists primarily of a novel mode of contracting the rim or neck of a hole or cavity which has been drilled or punched in a metallic plate, so that it shall embrace the pin or rivet, or overlap the screw seat which may be placed therein, and thus securely clinch and fasten the same. It consists, secondly, in the use of rivets or screw seats, so secured, to unite and fasten together metallic plates or bars, or the copper sheathing upon iron ships in the manner hereinafter particularly described.

In Plate X., fig. 1 represents in section the hollow punch used for the purpose of contracting or countersinking the edges of the cavities in which the rivets are to be secured. This punch A, is made of a suitably tempered metallic bar, having its lower end bevilled off to a point or rounded off in a convex form, so as to fit upon and into the mouth of the cavity to be countersunk. A recess *b*, is drilled longitudinally in the centre of this convex end of the punch, equal in diameter to the size of the pin or rivet to be secured in the cavity, and equal in depth to the length of such pin or rivet.

Having inserted a rivet *c*, in a simple cylindrical hole *d*, drilled or punched in the metallic plate B, (but which does not extend entirely through the plate) the hollow punch A, is placed over the projecting end of the rivet *c*, so as to rest upon the rim of the hole *d*; a blow is then struck upon the punch, causing it to drive in or countersink the rim of the cavity *d*, around the rivet *c*, so tightly and closely as to grip and hold even a straight rivet with great firmness. To ensure perfect security, the lower end of the rivet may be enlarged, as shown by *r*, in fig. 3, so that the neck of the cavity, when contracted as described, shall in a measure overlap the same.

This improved mode of securing rivets in metallic surfaces is especially adapted to the purpose of uniting plates where it is desirable that one of them should present an unbroken exterior surface, and that there should be no perforations through the same, as, for instance, in the armour of an iron-clad vessel or in the joints of heavy steam boilers. If the iron plates of the turrets in iron-clad vessels be secured by means of bolts fixed upon the outer side of the inner plates in the

manner hereinbefore described, it is evident that all danger to the inmates of the turret during an action, from the loosening of the bolts, will be prevented, as they cannot in any event fly inwards.

Again, this improvement is peculiarly useful in the sheathing of iron-clad vessels with copper, for it admits of the entire insulation of the rivets as well as of the sheathing itself. This is effected, where copper rivets or screw seats are used, by surrounding or enclosing the end of the rivet *c*, or the entire body of the screw seat *e*, (fig. 2) in an envelope or coating of rubber, paint, or other suitable insulating material, before placing it in the cavity, and it is quite evident that this insulating material will not be displaced by the countersinking or clinking in of the rim of the cavity around the same. By using screw seats of ebony, vulcanite, or other non-corrosive material instead of copper, the separation and insulation of the copper screw to be used therewith from the iron plate would be complete, and the fastening thereof still be perfectly firm and secure. The use of this improvement in the sheathing of iron vessels is illustrated by figs. 4 and 5.

Fig. 4 is a vertical section of a portion of the side of an iron vessel upon which the sheathing is secured by means of the invention. Fig. 5 represents in section a rivet having its lower end enlarged (so that it shall be more firmly held in its retaining cavity), and its outer end threaded to receive a nut, together with the manner in which it secures the sheathing upon the iron plate. Fig. 6 is a cross section, showing the manner in which the edges of the sheathing plates may be lapped over and locked together, to obviate the necessity of intermediate rivets.

It is evident that where the rivet or screw of copper, which is needed to secure the sheathing plates upon an iron vessel, is prevented from coming into direct contact with the iron by an insulating coating as just described, or by the use of a screw seat in itself non-corrosive, if the sheathing itself be properly separated from the iron by some insulating substance, there can be no possible danger of galvanic action. To effect such an insulation of the sheathing in connection with the mode of securing the copper sheets by means of the rivets hereinbefore described, a thin sheet of india-rubber or gutta-percha G, (figs. 4 and 5) or a coat of some suitable adhesive paint or cement, may be placed between the copper sheets H, H, and the iron surface K, of the vessel, to extend over the hull and up a short distance above the water line or point at which the sheathing terminates, as illustrated in fig. 4, or even to the very deck. In such case, the coated surface exposed above the sheathing is planked over, so as to protect it fully.

By the use of screws *f*, and screw seats *e*, in fastening on the copper sheets, the ready removal and replacement of the sheathing, or of any portion thereof, may be easily accomplished without injury to the hull of the vessel or the expense of forming new cavities therein. To obviate the necessity of using a great number of screws or rivets in sheathing a vessel, the edges of the plates may be held and fastened lengthways by thin copper battens E, E, (fig. 4,) which, although secured by rivets or screws to the hull, will, owing to their rigidity, require a comparatively small number thereof. The vertical edges of the sheathing plates whose remaining edges are held under the battens E, E, may be united together and secured without rivets by lapping them over upon each other, forming a lock joint as illustrated in fig. 6. It will be found

advantageous, when thus sheathing a vessel, to place close-fitting rings or washers of rubber around the shank of each projecting screw or rivet before placing the insulating coat or sheet over the vessel; as this will afford an additional precaution against the leaking in of moisture around the rivet.

The patentee claims, "securing bolts, rivets, screws, or screw seats in metallic plates, by contracting or driving in, upon, and around the bolt, rivet, screw, or screw seat the edge or rim of a simple cavity, into which they are first inserted in the manner described."

To Richard Archibald Brooman, *of Fleet-street, for an improved packing for stuffing boxes,—being a communication*—[Dated 7th November, 1864.]

This invention consists in substituting for the ordinary hemp and combustible packing an incombustible metallic thread packing, which retains the advantages due to a filamentous form. The fineness of the thread affords flexibility to the packing without the disadvantage of being combustible. The stuffing box is provided on the inside with a metallic thread rolled in multiple spirals; upon this thread is placed a ring composed of rope, or strands of textile or mineral material, such, for example, as amianthus.

The figure in Plate IX. represents, in vertical section, a stuffing box in which a metallic thread packing is employed. *a*, is the packing, composed of threads of brass or other metal, rolled in multiple spirals round the rod *b*, so as to fill up the space between the rod and the cone or socket *c*, fitted in the box *d*; *g*, is a ring or wrapping, of amianthus or other suitable material, over the thread *a*.

The patentee claims, "forming packing for stuffing boxes of incombustible metallic thread, substantially as described."

To George Bell and Robert Luthy, *both of Bolton, Lancashire, for a process for obtaining dense and flawless castings of metals and solid blocks of other substances, particularly desirable in the production of ingots for forgings, heavy pieces of ordnance, and hydraulic press cylinders.*—[Dated 14th November, 1864.]

It is well known that in the process of casting metals a considerable quantity of air and gases is contained in the liquid mass, and that an additional quantity of air or other surrounding gas is carried by the force of the stream with the metal into the moulds, and prevents the same from filling the entire space provided for it. Although the holes or pores thus made in the casting may be infinitely small, yet their large number will greatly diminish the strength of the castings; this, however, takes place not only in the casting of metals, but also in the casting and forming of blocks or solid masses of other substances. Where substances of a powdered, granulated, fibrous, or otherwise finely-divided state have to be formed into blocks, it is chiefly the air contained in and surrounding these small particles which prevents them from being sufficiently united by pressure or otherwise, and from forming one strong and solid mass.

In casting ingots or blocks of metals intended for forgings, it is not only the mere presence of the air or gas itself which it is desirable to avoid, but the air or gas forms with the surrounding metal oxides or other impurities, which prevent the metal from being intimately united or welded in the process of forging or pressing, and also from being of equal hardness throughout. To avoid this injurious presence and action of air and gases in the above-mentioned operations, it is proposed to prevent their admission, and to exhaust the same from the metal or other substance under operation, by creating a partial, or if possible complete, vacuum in the moulds, and, in case of liquid substances, particularly around the supply stream from the furnace, ladle, or other reservoir.

Ingots cast of iron, converted into steel by the "Bessemer" process, are particularly liable to contain a large number of blow-holes or pores, some of which are caused by air brought into the metal by the blowing process in the converter, or carried into the same by the stream in pouring from one vessel into another, as from the converter into the ladle and from the ladle again into the moulds; these holes are probably the most injurious, as their inner surfaces become oxidised, and cannot be welded together in the process of forging. Other holes or blisters arise from gases formed by the contact of the hot metal with the impure sides of the moulds. Holes are also supposed to be formed from gases taken up by the metal when under very high temperature, and ejected again while solidifying. Vacuum spaces are also formed by the contraction of the metal when cooling; the outer parts of the ingots having become hard are unable to follow the interior parts when contracting, and the latter thus tear away from the former at different places; these latter holes are less injurious, as their surfaces are very clean and easily weld together in forging.

Articles requiring to be made of strong and dense material, as, for instance, pieces of ordnance, shot and shells, and hydraulic press cylinders, may, by this invention, be cast of 'Bessemer' metal, which, as at present cast, will not admit of being applied to such purposes with safety. To attain this object it is proposed to apply a vacuum around the stream of metal immediately before it enters the mould, in order to prevent the admission of air which is usually carried into the metal by the stream, and to extract the air and gases already contained in the metal, and which are not able to disengage themselves from the same under the pressure of the atmosphere. The admission of air is prevented, and a vacuum is formed at this particular point, as it is here that the greatest surface of the metal is exposed to the air in the usual mode of casting, the whole of the metal having to pass in a thin stream. It is also at this point that the air and gases contained in the metal can be best extricated, and any gases forming in the mould are constantly exhausted as the metal rises in the same.

In Plate X., fig. 1 shows an arrangement for casting ingots of Bessemer metal. 1, represents the casting ladle, lined with fire-proof substance, and usually placed on the end of a hydraulic rotary crane 2; in the bottom of the ladle is the tapping apparatus, consisting of a cylinder 3, of fire-clay, set and fastened in a box 4, secured to the bottom plate of the ladle; a stopper 5, also of fire-clay, connected through an elongation 5^a, of its upper end, is bent over the top of the ladle to a

hand-lever arrangement 6, by which it can be raised or lowered on to the seat. The stopper 5, is usually simply ball-shaped, and has no elongation reaching into the cylindrical outlet hole. It projects downwards into the outlet hole, and is fitted with grooves all around, through which the metal has to pass, thus running into the moulds in flat thin streams, the metal presenting a very large surface to the action of the vacuum. 7, is a vacuum chamber connecting the ladle with the mould, in this case fastened to the ladle bottom, and made air-tight with the top of the mould by some pliable substance as clay or sand, adapting itself to the unevenness of the parts which have to form an air-tight joint during the casting. A pipe 8, connects the vacuum chamber 7, with the exhausting apparatus, and if necessary may be led through a water cistern placed on the crane, in order that the gases may not reach the exhauster in too hot a state. Instead of having an exhaust pump on purpose, the blowing engine, used for blowing the metal in the converter, may be made use of simply by connecting the pipe 8, with the suction pipe of the engine, and shutting off the supply from the outer air. A tube 9, is also connected with the chamber 7, having in its end a glass-covered press hole, through which the operator may see when the mould is full; 10, is the mould hooped in the usual way.

The mould has a flange near the top on which the vacuum chamber rests, the top of the mould being provided with lugs. The vacuum chamber may be fitted with a broad flange at its lower end, to suit different sized moulds, which in such case must be even on the top with lugs at the sides; it is not absolutely necessary that the vacuum chamber be fixed to the ladle bottom. The vacuum chamber may also be fitted with a funnel, lined with fire-clay and provided with a tapping apparatus similar to the one above described in connection with the ladle. This chamber may be placed on a mould and the metal run in from the usual casting ladle; this may be of particular advantage for very large ingots requiring more than one ladle full of metal, as the connection between the chamber and the mould will not have to be disturbed, and the vacuum can be kept up until the casting is complete. To ascertain when a mould is full, it may be placed on a weighing apparatus, or such an apparatus may be connected with the ladle to indicate the quantity discharged. To bring the ladle, vacuum chamber, and mould into close contact, the ladle may be lowered, or the mould raised. If an independent vacuum chamber, with a funnel on the top, is used for smaller moulds which can be filled from one ladle, the tapping apparatus need not be applied to the funnel. If the supply from the ladle is a little greater than the discharge into the mould, a vacuum can easily be maintained during the operation of casting, as the only communication between the mould and the outer air is stopped up by the metal itself.

In casting heavy pieces of ordnance, hydraulic press cylinders, shot, and any other articles, airtight pits or tanks with removeable covers, are used, in which the entire mould or a number of moulds can be placed, and the air exhausted therefrom; there being no communication with the outer air except through the inlets for the metal.

Fig. 2 represents such an arrangement for casting articles in air-tight chambers. A tank *a, a*, which may be made of several parts, is shown let into the ground, with a mould *b*, for a gun placed in it. The exhaust

pipe *c*, is fastened to the removeable cover *d*, on which is also placed the inlet funnel *e*, in this case provided with a stopper 7, so that the air may be exhausted from the mould and tank before metal is run in. A peep-hole may also be provided, so that the level of the metal in the mould may be ascertained.

In the production of blocks of other substances, as for instance bricks of clay or of sand and lime, blocks of artificial stone, artificial fuel made from small coal, peat, waste wood, blocks of wood from small divided wood, bales of cotton, wool, and similar substances, the exhausting of the air before and during the process of pressing will be of great advantage.

Where bricks or blocks of substances in a powdered or granulated state like sand, clay, and small coal, are pressed in moulds, it is proposed to perforate the sides of the moulds, and if necessary also the faller and the bottom plate, and bring these perforations into communication with an exhaust pump, so that all the air amongst the particles of the substance to be compressed is expelled during the operation of pressing. As some of the material may then fill up the perforations, it is proposed to employ the same air pump, or a separate one, to force these particles back again by compressed air when the moulds are empty.

The patentees claim, firstly, "the application of a vacuum around the stream entering the moulds in the process of casting metals, in the manner and for the purpose described. Secondly,—the apparatus consisting of parts 4, 5, 7, 8, and 9, of fig. 1, and the modifications of the same, as described. Thirdly,—the use of vacuum chambers or tanks and parts combined therewith, in the manner and for the purpose described. Fourthly,—the application of a vacuum in the formation of blocks of artificial stone or of other substances, in the nanner and for the purpose described."

To NICOLAS BAILLY, *of Vesoul, France*, CHARLES DURAND, *of Jussey, France*, GEORGE HOWARD MESNARD, *of the Wandsworth-road, and* ZACHARIE POIRIER, *of the Grove, South Lambeth, for improvements in the application of rolling friction to the axle-boxes and journals of running shafts and axletrees of machines and vehicles of all descriptions, for lessening the resistance to the motion.*—[Dated 14th November, 1864.]

THIS invention consists in applying to axles or shafts, or to a lining fixed thereto, a cylinder supported on spheres, which work upon a throat or shoulder formed on the lining shaft, or axle; the ends of the cylinder are cut away in a dished and coned form, to receive the spheres.

In Plate IX., fig. 1 is a longitudinal sectional view of the axle-box of a road carriage, where the wheel rotates and the axle is fixed. Upon the axle A, of the carriage is immoveably fixed a cylindrical piece B, on the exterior of which, at the ends, the throats *a*, *a*, are turned, and also two grooves *b*, *b*, in which roll spheres C. These spheres support a cylindrical envelope D, made in one, two, or more pieces, and the ends of which are coned out to receive the working spheres E, which rotate in or upon the throats or shoulders *a*, *a*, and in or upon the throats or

shoulders *e*, *e*, turned in the end plates F, which are fixed to the wheel by bolts or other suitable means, and which will be so arranged as to exclude dust and dirt from entering the box. It will be easily seen, from this arrangement, there can be no movement in the direction of the length of the axle, and only a rolling movement upon the spheres E, which spheres are embraced and kept equidistant by the cylindrical piece D, (which piece is carried round by the rolling action) turned horizontally in their onward progress, thereby ever changing the surfaces in contact. The effect of the cylindrical piece D, is such as to cause the working spheres E, to turn about in every sense, and the effect of the action of the part is such that the sphere has always a tendency to wear itself true; this cylindrical piece bears only its own weight on the spheres, and its duty being simply to keep the working spheres E, equidistant from each other, it has little or no work to do, and can never therefore develop frictional heat sufficient to render the bearings, shaft, or axle heated to any injurious extent.

Fig. 2 is an arrangement similar to that described in fig. 1, for a long bearing in carriages or machinery where the axle rotates, and the wheel is fixed thereto. The throats *a*, *a*, in this instance are turned upon the axle or shaft A, thereby dispensing with the cylinder B, which is not required in all cases.

To JULES AUBIN, *of Paris, for an improved millstone for grinding corn and other substances.*—[Dated 16th November, 1864].

THE improved mill-stone forming the subject of the present invention is shown in Plate X., where fig. 1 is a plan, and fig. 2 a vertical section of the same. B, is a metal plate, with a number of boxes A, cast upon it; each of these boxes is covered at top with metallic or other cloth C. D, is the stone proper; it is set upon the plate B, occupies the centre, and fills up the interstices between the boxes A. In the rotation of the ordinary upper stone X, the grinding takes place in the ordinary manner between the two stones X, and D, the flour falls into the boxes A, through the cloth C, while the bran or envelope is, as before stated, projected from the circumference of the stone. To facilitate the bolting, and prevent the flour remaining on the cloths C, an intermittent agitation of the upper part M, of the boxes which receives the cloths is produced. For this purpose an annular space is formed round the periphery of the stone D, between the upper and lower plates B^1, and B, in which space, at any convenient point, is fitted an excentric E, actuated by a shaft *b*. The excentric E, by contact with a block T, on which is a ring or disc *f*, produces a slight movement of this ring. The ring gives a proper contour to the stone D, and on its surface are formed blocks *g*, which by butting against the ends of the upper parts M, of the boxes, impart to these parts a shaking movement, which again produces a movement of the cloths C, and thereby prevents adhesion of the flour and facilitates the bolting by a sifting motion. The ring *f*, may be connected by links or articulated joints *i*, (see the detached views figs. 3 and 4), or other analogous arrangement. The connection of the ring *f*, with the blocks *g*, can be avoided, or these blocks can be dispensed with, by casting with the ring keys equal in number to the parts M. In

the slight alternate movement imparted to the disc by the excentric E, these keys which receive the ends *h*, of the parts M, transmit to them the vibratory motion which facilitates the bolting. The plates B, B[1], are prevented from shaking by blocks placed between them, or in any other convenient manner. The upper parts of the boxes can be lowered when required, in order that as the stone D, becomes worn, they may be prevented from coming in contact with the upper stone X. The number, position, size, and shape of the boxes A, may be varied at will.

The patentee claims, "constructing millstones with metal boxes or compartments let into the stone and covered with metallic or other cloth, in the manner described."

To THEOPHILUS ALEXANDER BLAKELY, *of Montpelier-square, for an improvement in working guns.*—[Dated 18th November, 1864.]

THIS invention consists in the employment of a counterpoise or weight connected to the rear part of a gun for the purpose of facilitating the working of guns which are to be fired from port-holes or embrasures of a contracted size.

The figure in Plate X., is a side elevation of a gun on a carriage and platform. A, is the gun pivotted on its trunnions B, near the mouth of the gun; C, the gun-carriage; and D, the platform; E, is the counterpoise free to rise and fall with the working of the gun. It is attached by ropes or chains F, passing over pulleys or rollers, and secured to the rear of the gun.

The patentee claims, "the employment of a weight or counterpoise substantially in manner described."

To JOSEPH PHILLIPS, *of Great Suffolk-street, Southwark. for improvements in apparatus for the prevention of accidents in connection with steam boilers.*—[Dated 19th November, 1864.]

THIS invention consists in so arranging a float inside a steam boiler, or in a vessel in communication therewith, in combination with a loaded valve or cock situated outside the boiler, and closing in a passage through which the water space of the boiler or other receptacle containing water can communicate with the fire, that upon the water line of the boiler falling below a certain level, the float is caused to open the valve, so as to allow of the water from the boiler or elsewhere being injected upon the fire, in order to extinguish the same. The valve may also be so arranged as to be acted upon and opened by the pressure of the steam in the boiler, so as to inject water into the fire.

In Plate X., fig. 1 shows, in partial front elevation, a Cornish boiler, with the arrangement applied thereto. *a* is the boiler, with a portion of the end plate *b*, removed; *c*, is the stone float connected to the lever *d*, which is fast on the spindle *e*; *f*, is the balance weight to the float *c*. The spindle *e*, is carried by the bracket *g*, inside the boiler, and passes through a stuffing box *h*, in the end plate *b*, outside the boiler; a lever *i*, is fixed to the spindle, carrying a looped link *j*, in the loop of which is inserted the end of the weighted lever *k*, of the valve

l; this valve closes the end of the pipe *m*, which passes inside the boiler, and down to below the lowest possible water level, where it is open. To the valve box of the valve *l*, is attached another pipe *n*, communicating at one end with the space above the valve, and at the other end with the fire-grate of the boiler. Thus, if the water level sinks down to such an extent as to cause the float *c*, to draw the lever *i*, into the position *x*, shown in dotted lines, the bottom of the loop *j*, will just come in contact with the weighted lever *k*; and upon the water sinking at all below that level, thereby endangering the safety of the boiler, the weight of the float will cause the lever *k*, to be raised, as indicated by the dotted lines; whereupon the pressure of steam in the boiler will cause the water in the pipe *m*, to force open the valve *l*, and to flow through the pipe *n*, on to the fire-grate, so as to extinguish the fire, and thus prevent the explosion or deterioration of the boiler. In order to spread the water as much as possible upon the fire, a plate *p*, is fixed over the opening of the pipe, upon which plate the water impinges, and is thereby spread out in a sheet. The weight *q*, on the lever *k*, is so adjusted, that when the pressure in the boiler exceeds that which it can bear with safety, such pressure will force open the valve, irrespective of the level at which the water may stand, and will cause the water to be thrown on the fire, as above described. To the spindle *e*, is also attached an index hand *c*, which, in moving with the spindle as the float *c*, rises or falls, is made to indicate upon the scale *s*, the height of the water in the boiler.

It will be evident that the apparatus may be varied in carrying this invention into practice. Thus, when only slight variations in the level of the water in the boiler are allowed, the float arrangement may be modified, as shown in fig. 2, where *c*, is a hollow metal float attached to the double-ended lever *d*, which turns upon the ball-and-socket joint formed in the gland *h*, in the end plate *b*, of the boiler. To the short arm of this lever is attached the looped link *j*, actuating the weighted lever *k*, of the valve *l*, as before described. Again, instead of applying the before-described apparatus to the boiler itself, it may be connected to a separate vessel communicating with the boiler; or the float, levers, and valve may be attached to the boiler, as described, and the pipe *m*, made to communicate with a separate cistern of water. The loaded valve *l*, with the pipes *m*, *n*, may also be employed without the float arrangement, in which case the apparatus would act only in relation to the pressure of steam in the boiler.

The patentee claims, "Firstly,—constructing apparatus for preventing the explosion of steam boilers, in which a float inside the steam boiler, or in a vessel communicating therewith, is so arranged in connection with a valve or cock situated outside the boiler, and closing a pipe or pipes communicating with the water space of the boiler, or with a separate cistern and with the fire-grate, that upon the water sinking below a certain level, the sinking of the float will cause the said valve or cock to be opened, so as to allow of water from the boiler or elsewhere being injected on to the fire; also, in combination with the above, the arrangement of an index upon a spindle actuated by the float for indicating the water level upon a graduated scale. Secondly, —so arranging a loaded valve situated outside the boiler, and closing a pipe or pipes communicating with the water space of the boiler and

with the fire-grate, that upon the pressure of the steam in the boiler exceeding certain limits, the valve shall be opened by such pressure, and allow water from the boiler to be injected into the fire. Also combining with the above the float arrangement described in the first claim."

To JOHN WHITE, *of Finchley, for improvements in means or apparatus employed in purifying, changing the temperature, and impregnating atmospheric air, which improvements are also applicable to the purification or separation of gases or vapours, and part of which improvements is also applicable in obtaining motive power for other purposes.*—[Dated 24th November, 1864.]

THIS invention relates to means or apparatus by which atmospheric air may be acted upon for the purpose of its purification, or its change of temperature, or its impregnation. For this purpose the air in motion, obtained by a fan or other suitable blowing or forcing apparatus, is caused to pass through or between filaments, strands, or texture of wool, or of other suitable material adapted to operate by capillary attraction, to receive and hold in suspension water or other purifying, cooling, warming, or impregnating fluid supplied from a suitable reservoir.

In Plate IX., fig. 1 represents an arrangement of apparatus employed for purifying, changing the temperature, or impregnating air according to this invention.

A, is a water-tight vessel, supported upon rods B, at a certain distance above a fan case C, consisting of an upper circular plate of metal C^1, and a lower similar plate C^2, with an open periphery: both plates C^1, and C^2, have a central circular opening D^1 and D^2, through which air arriving by the open spaces E^1, and E^2, is drawn by the fan F, affixed to the spindle G, which is caused to rotate by means of suitable motive power applied to it. The upper vessel A, is surrounded with woollen or other suitable threads, or with suitable texture H, which, being secured by their upper end, or edge J^1, to a perforated metal ring K^1, held in position by means of catches or hooks near the bottom of the interior of the vessel, are allowed to hang over the rim L, and dip with their lower end or edge J^2, into a vessel M, where they are secured to a perforated metal ring K^2, held in position by means of catches N. On soaking the threads or texture H, and pouring water or a solution into the upper vessel A, the fluid thence has a tendency to be exhausted from the vessel A, by the capillary action of the threads or texture H, and then to descend by gravity into the vessel M; and the air to be acted on is both drawn in and discharged through the wetted threads or texture H, in its passage into and out of the fan case, and is thereby purified, cooled, warmed, or mixed with other matters, as the case may be. The lower vessel M, has in the centre a water-tight socket, through which the fan spindle G, passes; it has also a cock P, through which the surplus fluid may be drawn or allowed to flow off. This part of the improvements is also applicable as an inhaler.

Figs. 2 and 3 represent, in a vertical and transverse section, one form of apparatus adapted as a portable inhaler for purifying or otherwise acting on air for the purpose of respiration.

A, is a water-tight vessel, to which are attached tubes B^1, B^2, of india-rubber, for the ingress or egress of air during inhalation. In the interior of the vessel A, is another water-tight vessel, C, on each of the sides C^1, of which is soldered vertically a convenient number of perforated metal strips D^1, of such width that the narrow width C^2, of the vessel C, together with such strips, will be just that of the narrow width of the interior of the vessel A. Threads of wool, D^2, are attached in their middle between slips of wood D^3, which may be screwed together and placed on the bottom of the interior of the vessel C, whilst the ends of these threads are allowed to lie over the rims E^1, and E^2, of the sides C^1, of the vessel C, and are thence threaded zig-zag downwards through the perforations, which should be wider than the threads of the metal strips D^1, at the bottom of which they are tied to prevent their displacement. The vessel C, is inserted into the vessel A, at the neck or opening F, which is provided with a cover G. H, is an aperture for letting off the surplus fluid. Air entering the vessel A, by the tube B^1, will, by inhalation through the inhaling tube B^2, be drawn through and over that portion of the threads which are threaded in the perforated metal strips D^1, and which threads are kept wetted by the fluid which has been put into the vessel C, acting by the capillary process as before described; and thence such air passes to the inhaling tube B^2. This tube B^2, may be provided with a suitable mouthpiece and double-action valves, so as to admit into the lungs only air that has passed through the apparatus.

Fig. 4 represents a vertical section of an arrangement of apparatus adapted to maintain the motive power in carrying out the improvements. On a circular opening a^1, in the centre of the upper part and on a circular opening A^2, in the centre of the lower part of a concentric or excentric fan case B, are respectively fixed cylindrical chambers C^1, and C^2, each of which is open at each end, and is provided with one or more air-receiving apertures D^1, D^2, and the other extremities of such cylindrical chambers furthermost from the fan case is fixed around the open vertex of a (by preference) conically-shaped reservoir E^1, or E^2, which has at its base an aperture F^1, or F^2, for filling and draining purposes, furnished with a plug; both cylindrical chambers C^1, and C^2, and both reservoirs E^1, and E^2, having the same capacity and form. Each of the reservoirs, E^1, and E^2, has in its interior at the vertex a ball valve confined by a bar G^1, or G^2, and in its slant side just above the ball valve, a little further towards the base, a tube H^1, H^2, for conducting, by gravity, the fluid contained in the reservoir E^1, or E^2, which for the time is uppermost, into the fan case B, where it acts to exert the motive power required by striking on the vanes of a fan J. In the interior of each of the reservoirs E^1, or E^2, is an anti-vacuum tube K^1, or K^2, to admit of air passing into that one of the reservoirs E^1, or E^2, which for the time is uppermost, as the fluid passes out of such uppermost reservoir to exert power. Each of these anti-vacuum tubes K^1, and K^2, extends with one end to the base of the reservoirs E^1, or E^2, whereas the other end terminates in the cylindrical chambers C^1, or C^2. On bringing the apparatus into a perpendicular position, and filling the upper reservoir with the desired fluid, this, owing to the pressure of the air that enters by the uppermost of the anti-vacuum tubes K^1, or K^2, and finding no egress at the vertex of the reservoir, on account of the ball

valve, escapes by gravity through the uppermost of the tubes H[1], and H[2], into the fan case B, there striking on the vanes of the fan J, and so causing it to rotate and to eject at the outlet L, the air which has been drawn in at the openings D[1], and D[2], through the cylindrical chambers C[1], and C[2]. The surplus fluid then flows through the lower central opening A, of the fan case, and thence through the lower cylindrical chamber C, into the lower reservoir E. And in order to effect greater contact of the air and fluid inside of each of the cylindrical chambers C[1], and C[2], a lining or hollow cylinder of suitable fabric, M[1], or M[2], may be placed, having one end or edge attached to a perforated rim M[3], or M[4], surrounding the upper and lower openings A[1], and A[2], on the fan case, and with their other end or edge falling over the end of the air receiving apertures D[1], and D[2], the lining or cylinder of fabric which for the time is lowermost will be kept constantly wetted with the surplus fluid flowing from the fan case. N[1], and N[2], are metal discs fitted in a water-tight manner, to prevent useless accumulation of fluid in the spaces O[1], and O[2]. The spindle of the fan J, falls into a groove in the metal bar P[1], placed across the bottom of the interior of the fan case, and is held at its upper end in a groove in a screw in the upper bar P[2]; by turning this screw, delicate adjustment of the fan J, is attainable. When the contents of the reservoir which for the time is uppermost have entirely passed into the lower one, the apparatus may be reversed, by doing which the ball valve of the reservoir now filled closes the egress at the vertex, whereas, *vice versâ*, the ball valve of the empty reservoir falls, thus giving ingress to the surplus fluid coming from the filled reservoir, and so on.

The patentee claims, "First,—the action upon atmospheric air for the purpose of purifying, changing the temperature of, and impregnating the same by water, or water mixed with other matters by capillary process, as also the action upon gases or vapours, for the purpose of purifying or separating the same in manner substantially as explained. Second,—the adaptations or combinations of means for obtaining motive power in apparatus for purifying, changing the temperature, and impregnating atmospheric air, or for the purification or separation of gases or vapours, and the application thereof in obtaining motive power for other purposes."

To JAMES MCINTOSH, *of Dundee, for improved apparatus for giving pressure to the drawing rollers of preparing and spinning machinery.*— [Dated 30th November, 1864.]

THIS invention relates to an arrangement of apparatus for insuring to the drawing rollers of preparing and spinning machinery used in the manufacture of flax, jute, hemp, silk, wool, or other fibrous substances, a more equable pressure (which is capable of exact adjustment) than can be obtained by the usual mode of levers and weights.

The fig. in Plate X. shows the improved apparatus as applied to give pressure to a pair of pressing rollers of dry spinning frames for flax, hemp, or jute.

A, A, is the ordinary grate or bar of the spinning frame, and which serves to guide the wooden pressing rollers behind the drawing rollers.

From this grate A, projects a forked rod B, which is held firmly in position by means of a screw and clamping nut. To the forked end of this rod is jointed a pendent lever C, which, at a short distance from its fulcrum, is embraced and secured by a pivot pin to a forked socket-piece D. This socket-piece is tapped to receive the screwed end of a rod E, which carries at its other end a bearing for the axle of the wooden pressing roller F. To the bottom end of the pendent lever C, there are attached by a swivel joint pin *c*, plates of tempered steel G, which extend downwards below a longitudinal beam H, of the spinning frame. The bottom ends of the steel spring plates are secured together by a rivet, and inserted in a catch fixing I, attached to the beam H. The regulation of the amount of pressure to be put upon the drawing roller K, is effected by simply turning the screwed rod E, so as to enlarge or decrease the distance between the axle of the pressing rollers and the pendent lever C. To permit of this regulation, it is necessary first to remove the pressure of the spring plates from the pressing rollers; this is done by turning the spring plates on their coupling pin *c*, and thus releasing them from the catch I; the rod E, is then free to be screwed in or out, as required.

The advantages attending the application of this improved apparatus are—that the levers and weights of the usual system are dispensed with, thus avoiding the accidents and inconvenience that were caused by them; a much more steady pressure is insured, which not only produces a much more evenly-drawn sliver, but causes great saving in the wooden pressing rollers, which will consequently be found to last much longer than usual. This invention, by some slight and obvious modifications, admits of being applied to the pressing of drawing rollers for other kinds of flax-spinning and preparing machinery, or for the machinery used in preparing and spinning silk, wool, or other fibrous materials.

The patentee claims, "the arrangement of apparatus above described for providing an adjustable pressure for the drawing rollers of preparing and spinning machinery."

To MARTYN JOHN ROBERTS, *of Pendarren, near Crickhowell, Brecknockshire, for improvements in means or apparatus for reducing the friction now produced by the longitudinal or endlong pressure of ships' screw-propeller shafts, or of any upright or inclined shafts when revolving.*—[Dated 1st December, 1864.]

THIS invention consists in receiving the thrust or endlong pressure of propeller and other shafts upon a fluid under continual pressure, whereby the friction that would ensue between the end of such a shaft when revolving and a solid support is in a great measure avoided. If an unelastic or nearly unelastic medium, such as water, is used, it is preferred to combine with the apparatus an air vessel, for giving elasticity to the medium. Without such elasticity, injurious jerks and blows would be created in the shaft, and between it and any solid bearings it might come into contact with. Again, it is sometimes desirable that the shaft should be, as it were, divided in its length, so that the portion actually impinging upon the

fluid bearing should be independent of the main portion of the shaft, to the end that should the main or principal portion of the shaft sink in its bearings, it should not cause that part of the shaft supported endlong by the fluid medium, to press severely on the sides of the box or cylinder, hereafter described, which contains it.

The figure in Plate IX. shows in section the manner in which the invention is carried into effect. A, is a screw-propeller shaft; B, the inboard end; C, is a hollow plunger, which may be in a piece with, or, preferably, in a separate piece from, the shaft; D, is a cylinder or case in which the plunger is free to revolve and play. *a*, *a*, are annular recesses in the outside of the plunger; E, is a pipe communicating with a force pump F, and also by the pipe *b*, fitted with a stop-cock *c*, with an air vessel G.

The patentee claims, "reducing the friction produced by endlong pressure of screw-propeller and upright or inclined revolving shafts, —first, by the employment of fluid under continual pressure, substantially in manner hereinbefore described; and, second, by the employment of liquid under continual pressure, together with an air vessel connected to the pipe, whereby such pressure is conveyed, all substantially in manner and for the purpose described."

To JOHN GANO WINTER, *of Chester, for improvements in revolving retorts and in the mode of applying heat to the same, designed for producing oil from coals, shales, cannels, and other substances, or for distilling oils.*—[Dated 5th December, 1864.]

THIS invention consists in the application of the active heat to that portion only of the retort where the interior surface is covered by the substance being decomposed, and the means employed for limiting and regulating the said application, in order to prevent so far as practicable any injury to the extracts obtained from the substances, and thereby economising fuel and time in the process of decomposition, by the use of thinner material in the construction of the retort.

In Plate X., fig. 1 is a longitudinal section of the improved retort; and fig. 2 is a transverse section of the same. A foundation or support A, is constructed of brickwork or other suitable material; and on it are fixed the bearings *a*, for the journals of the revolving retort B, to work in. The retort B, is of the usual form, and may be constructed of wrought or cast iron. C, is a hollow shaft extending from end to end through the interior of the retort, and securely fixed to the ends thereof. The ends of the shaft are supported in the bearings *a*, and the retort B, and shaft C, revolve together. The apertures *b*, in the hollow shaft C, are made to allow the vapour distilled from the substance being decomposed, to pass off in the direction indicated by the arrows into any form of condenser.

D, D, are the elevating ribs or brackets, extending the entire length of the retort. These ribs may either be made of T iron, rivetted or otherwise secured to the interior of the shell of the retort, or they may be formed by flanges of the cast-iron segments composing the shell of the retort. E, is the coal or other substance to be decomposed; F, is the furnace; and G, is the jacket encasing the upper

portion of the retort. This jacket may be made to open so as to reduce the temperature of the retort when required, and to render any part of the retort easy of access for repairs.

H, and H[1], are dampers, extending the entire length of the retort, and so arranged as to close when required the space between the sides of the foundation A, and the side of the retort B, in order to prevent a current of heated air passing round the portion of the retort not covered by the coal or other substance. The dampers H, and H[1], are made to work on hinged joints *d*, so that their edges *e*, and *e*[1], may rest upon the surface of the retort B, without causing any obstruction to the motion of the retort. The damper H, is made to rest upon the surface of the retort, at such an angle as to be kept in contact with the surface by the weight of the material forming the damper, while the damper H[1], being on the under side of the retort B, is kept in contact therewith by means of the weight *f*, fixed on the arm or lever *g*.

Instead of the dampers being kept in position by means of weights, as shown, springs or other like means may be employed for that purpose; the object being to confine the application of the active heat to that part of the retort covered by the coal or other substance being decomposed. The heated surface being so limited, the active heat from the furnace is communicated more directly and undividedly to the coal or other substance treated than in any apparatus heretofore employed, and the fuel is economised. The active heat being shut off from that part of the retort occupied by the vapour, a higher degree of heat may be maintained in the furnace without superheating the vapour, and thus the process of decomposition may be carried on with greater rapidity without impairing the quality of the oil or other products eliminated.

The operation of the improved retort is as follows:—The coal or other substance treated being placed in the interior of the retort, the fire is lighted in the furnace F, the flue damper I, is opened, and the retort B, is caused to revolve by any suitable means. The active heat and products of combustion, which in the apparatus at present in use pass entirely around the perimeter of the retort, by this improved arrangement are limited to that portion of the under surface of the retort contained between the dampers H, and H[1]. The heated air and products of combustion after traversing the same escape through the flue J. Now it is obvious that, as the retort revolves in its bearings, every part of its exterior is brought successively in contact with the heated air of the furnace; but since the coal or other contents of the retort shifts so as always to cover the part so in contact, a great proportion of the heat contained in that part is abstracted and absorbed by the contents of the retort before that part comes in contact with the vapour in the part not in contact with the substance being treated. The heat being thus rapidly absorbed by the contents of the retort, the retort may be constructed of thinner metal, and therefore at a less cost than heretofore, and the consumption of fuel is greatly reduced.

In order that the substance to be treated may be thoroughly and rapidly shifted, and thus be brought into complete and uniform contact with the surface of the heated metal, the elevating ribs or brackets D, extending the entire length of the interior of the retort, are preferably

made not less than three and one-fourth inches in width, and wider if necessary.

The patentee claims, "the invention substantially as set forth."

To JAMES PURDEY, *of Oxford-street, for improvements in breech-loading firearms.*—[Dated 14th February, 1865.]

THE first part of this invention consists of an improved "action" adapted to that class of firearms in which the barrel is mounted on a horizontal pin, and works in a vertical plane for opening and closing the breech.

In Plate IX., fig. 1 represents part of a gun stock showing the first improvement, which relates to an improved mode of locking the barrel in its place in the stock. The locking bolt is shown at *a*, and is placed vertically in the body of the action. To lock the barrels, the bolt enters a recess or notch cut in a steel-piece *b*, attached to the barrels *c*, and is held firmly in its place by means of a wedge-shaped vertical sliding bolt *d*, operated by a rocking lever *e*. This lever is placed under the strap or tail-piece *f*, and works on a horizontal pin 1, which passes through the strap *f*. The forward end of the lever *e*, enters a slot cut in the wedge-shaped bolt *d*. At the other end of the lever *e*, is placed a projecting stud or button *i*, which passes up through the strap or tail-piece *f*, so that by pressing down the stud or button *i*, the wedge-shaped bolt *d*, is lifted up, thereby allowing the locking bolt *a*, to be thrown back, and the fore end of the barrels *c*, to fall, so as to open the breeches ready to receive the cartridges. In throwing up the fore end of the barrels *c*, to close the breech again, the bolt *a*, is pressed forward by the steel-piece *b*, and the wedge-shaped bolt *a*, is forced into its position by means of a spring *j*. This mechanism for locking the breech may, in addition, be provided with an action for locking the trigger. This is shown in fig. 2, and is effected by means of a lever *k*, placed behind the trigger or sear *l*. The fore end of this lever is kept against the sear or trigger *l*, by means of a spring *m*. The other end of the lever *k*, rests on a pin *n*, connected to a lever *o*, at the back of the trigger guard. The pin *i*, of the lever *e*, is in this case lengthened, and passes down through the spring *m*. On pressing the pin *i*, down, its lower end will come against the lever *k*, and by preventing it from rising will lock the trigger *l*. When the gun is charged and ready for firing, the trigger will remain locked, until the hand which grasps the small of the stock forces up the lever *o*, and pin *n*, and thereby depresses the fore end of the lever *k*, and releases the trigger *l*.

Fig. 3 shows a modification for locking the barrels. In this arrangement, a lever *p*, is placed under the trigger guard, and works on a pin 2, in the trigger plate. This lever *p*, is connected to the wedge-shaped bolt *a*, by a pin *q* jointed to or connected with the short end of the lever *p*; so that by pressing the lever *p*, forward, the wedge-shaped bolt *d*, will be lifted up, and the breech of the gun opened. In shutting up the barrels, the gun will be self-locking, by means of a spring or springs, as shown. The second improvement relates to an improved striking action, and consists in drawing back the striking bolt, by means of the hammer. This part of the invention is applicable to that

class of breech-loading guns which have their ignition or fulminate in or near the centre of the cartridge, and is shown at fig. 4, which is a side view of a gun with this improvement adapted thereto, and showing the breech open, and the barrels drawn back. Fig. 5 is a sectional plan view of the same. The striking bolt *r*, works in or over the lock plate *s*, and through the breech piece, and a projection on it is struck by the hammer when it descends.

A projecting cross-pin or stud, on the end of the striking bolt, works in a slot or groove made in the hammer, so that in drawing back the hammer, the latter pulls back the striking bolt *r*, until the lock works into half-cock, after which, in consequence of the curved form of the groove, the hammer will not pull back the bolt *r*, any further. The above action may be adapted either to those central-fire breech-loading guns, the barrels of which work on, or are hung on, a pin, as shown at figs. 1, 2, and 3, or to those in which the barrels are slidden forward in grooves, by means of levers, as shown at fig. 4. In the latter arrangement, the barrel is prevented from being opened or closed, until the hammer is drawn back to half-cock, by means of a nib *t*, standing on the top of each barrel at the breech: upon this the hammer falls, so that the barrel *c*, cannot be pulled forward, until the hammer is raised to half-cock, or if the gun has been discharged and a fresh cartridge has been put in, the barrel cannot be drawn back home, if the hammer be accidentally let down, until the same is drawn up to the half-cock, in order to let the nib *t*, pass. Another improvement relates to central-fire breech-loading arms, in which cartridges containing their own fulminate are employed, and in which the cartridges are exploded by means of a pin striking the central part of the rear end of the cartridge.

The improvement consists in providing the cartridge with a pin or stud which projects up through the breech, so that when the breech is opened, the cartridge may be pulled out by simply laying hold of the projecting pin. If desired, the hammer may be constructed with a moveable nose, which is to be screwed or otherwise fastened on temporarily when required, so that, should the sportsman be unable to obtain central-fire cartridges, he may make use of ordinary pin cartridges, by simply fastening on the nose piece on his hammer.

The next improvement relates to an improved cartridge extractor, which is shown at fig. 6. The extractor *v*, is adapted to the barrels by means of a pin v^1, and is worked by a lever *w*, mounted on a pin *s*, which goes through the steel lump *b*. The top, or extractor part, is provided with a guide pin v^1, which keeps it always in position. The extractor lever *w*, is actuated by a projecting tumbler or lever *x*, on the breech piece, provided with a coiled spring, which bears against the back of the tumbler *x*. When the barrels *c*, are being opened, the tail of the extractor lever *w*, is forced back by coming against a tumbler lever *x*, and the extractor is thereby forced out, as shown, and with it the cartridge.

Breech-loading guns, the barrels of which slide forward on a horizontal plane, instead of turning on a pin, must be provided with a cartridge extractor of somewhat different construction. This is shown at fig. 4, and may be worked as follows. A small extractor *w*, in the shape of a lever, is mounted on a pin *s*, and works through the body.

As the barrels *c*, are closed by being pushed back, the extractor lever *w*, is moved back on its pin by the projecting rim of the cartridge, until the latter is passed over it. The point of the extractor *w*, will then be thrown up by means of a spring 4, which works on a notch on the lever. When the barrel is drawn forward to open the breech, the sharp upper edge of the extractor lever *w*, will hold the head of the cartridge back, and so force it out as the barrel is drawn forward. The cartridge is prevented from rising out of its position, by means of a rib *y*, at the top of the breech plate. In order that one extractor may be used without the other, so that either cartridge may be withdrawn, leaving the other in its barrel, the extractor levers *w*, are provided with tails w^1, which project below the stock, so that the sportsmen, by pushing back the tail w^1, of either extractor lever with his thumb, will be able to relieve the point of the extractor from the flange of the cartridge, when the breech is being opened, and by so doing, the cartridge will be left in the barrel.

The patentee claims, "First,—the improved mode or modes herein shown for locking the barrels; also the combination of the trigger locking apparatus with the arrangement for locking the barrels. Secondly,—the improvements set forth in the striking action applicable to central-fire cartridges. Lastly,—the improved constructions of cartridge extractors described."

Scientific Notices.

MECHANICAL ENGINEERS' SOCIETY.

January 26th, 1865.

ROBERT NAPIER, Esq., President, in the Chair.

The paper read was, "*On the relative advantages of the inch and the metre as the standard unit of decimal measure*," by Mr. John Fernie, of Leeds.

The subject of a decimal system of measure resolves itself into two distinct questions, the *desirability* of a decimal system, and the *standard of measure* to be adopted as the unit of the decimal system.

The principle of a decimal system of measurement is now considered to be so advantageous and desirable by the practical and scientific men who have entered into the subject, that sooner or later the irregular and inconvenient system hitherto used in this country must be expected to give place to one more suited to the present times. The permissive bill of 1864, which legalised, by Act of Parliament, the use in this country of the present standards of measure decimalised, and also of the French standard, the metre, is the first public step in that direction; and consequently the question as to which standard is to be finally and exclusively adopted for use in this country has now become an important

and urgent practical question. The adoption of the metre system in its entirety, both for measures and weights, has been strongly advocated by a very influential committee, and the object of the present paper is to compare the standards for measure of length, and to show the practicability of adopting a decimal system founded on the inch at present used in this country, and the advantages that the inch possesses over the metre as the standard unit of measure.

The first question of the *desirability* of a decimal system of measure may now be considered settled, and the principle definitely adopted in this country: but the second question of the *standard of measure* is still open, and is a very important one for consideration, on account of the number of circumstances affecting it.

The grounds on which the adoption of the metre has been urged are, the existence already of a complete decimal system of measure and of weights based on the metre, and its use as the standard of measure by the large and important population of the French empire and several other countries: the object being to obtain, if possible, a universal standard of measure for the whole civilised world, on account of the great advantages that would attend the universal use of the same system of measures in the rapidly extending international communications.

The consideration of the *standard of measure* involves two distinct classes of requirements that have to be met as far as practicable, which need a separate examination, namely:—those involving *scientific questions* for preliminary investigation; and those that are *practical conditions* necessary to be fulfilled before the object can be really carried out.

The scientific questions involved may be stated as follows:—

1st. The standard to be the one that can be replaced best in case of being accidentally lost.

2nd. The standard to be the one most universal in the character of its basis of reference.

The practical conditions involved may be stated as follows:—

3rd. The standard to be the one best suited for use in decimal subdivision.

4th. The standard to be the one most extensively and influentially in use already, and consequently involving the least alteration of existing measures.

1st. In considering the question of the standard that can be best replaced, if lost, there appears to be no real choice between the metre and the inch in this respect. The length of the metre was originally determined by measuring a portion of a quadrant of the earth's polar circumference; but its length was also referred to the length of a seconds pendulum, on account of the much greater facility for accurately repeating the measurement of a pendulum than the extremely difficult and complicated operation of measuring an arc of the earth's circumference. The length of the metre was consequently defined in 1798, by Borda, one of the commissioners for determining the French national standard, by giving 0·99385 metre as the length of a seconds pendulum at Paris, making 86,400 oscillations in twenty-four hours and vibrating in vacuo at the sea level, and at the temperature of freezing water.

The length of the inch was defined in 1824, by the declaration, by

Act of Parliement, that 39·13,929 inches is the length of a seconds pendulum in the latitude of London, vibrating in vacuo at the sea level and at the temperature of 62° Fahr. Consequently both the metre and the inch can be verified by the same means—the measurement of a pendulum; and indeed, the relation between them having been once established, it follows that whatever means is used for verifying the one, is equally available for verifying the other.

2nd. In regard to the second point—the standard that is most universal in the character of its basis of reference—the metre was formerly supposed to have a marked superiority over the inch, as it was originally intended to be exactly the 1-10 millionth part of a quadrant of the earth's polar circumference, the basis of measurement to which it was referred; whilst, on the other hand, the inch was an uneven fraction of the length of the pendulum. The result, however, of subsequent and more accurate measurement has been to show an error of 1-6404th part deficiency in the original measurement of the metre, which was effected in 1794, by the measurement of an arc of about 630 miles length, extending through France from the coast at Dunkirk to Formentera on the coast of Spain, the measurement of which was carried out under unusual difficulties in time of war. In consequence of this error in the original measurement for the standard, the length of the metre has now to be defined by an uneven fraction, as is the case in defining the length of the inch. The further result, however, of recent investigation has been to show that a quadrant of the earth's polar circumference is not, as was previously supposed, a uniform quantity, and it is therefore not a suitable basis for determining a standard unit of measure; for it has been found that the form of the earth at the equator differs from a true circle, its longest equatorial diameter exceeding its shortest by 1-3941th part, and there is consequently a variation in the lengths of different quadrants of the circumference measured from the pole to the equator. As regards the universality of its basis therefore, there is no choice between the metre and the inch.

It has to be noticed that the present legal standard of measure in this country is really an individual standard metallic yard measure, which was legalised by Act of Parliament in 1855; this had been prepared with all possible care by comparison of all existing standards of authority, the former legal standard, a metallic yard measure, made by Bird in 1760, having been destroyed by fire in the burning of the Houses of Parliament in 1834. In consequence, however, of some sources of error having been discovered by subsequent investigations in the former process of measuring the seconds pendulum, all reference is omitted in this last Act of 1855, to the means of verifying the standard by the length of the pendulum, and the only provision made against a loss of the standard is by legalising certain duplicates that were made from it with the greatest care as secondary standards. The present standard of measure is therefore really an individual metallic yard measure, forming the legal standard independent of any reference to another source: and the metre may indeed be considered to be in a similar position, since it is a continuation or copy of the original metre, which is now known to differ from the measure of the earth's circumference that it was intended to represent, while the amount of error at

present ascertained may probably undergo still further correction by future still more accurate observations.

The circumstances, however, of depending upon accuracy of copying for the preservation of a standard, though theoretically objectionable, is not practically a disadvantage as regards accuracy. For with the extreme degree of perfection now attained in copying measures of length by Mr. Whitworth's process of contact measurement, the accuracy of measurement can be carried as far as one millionth of an inch, which is a considerably higher approximation than can be attained in any present process of determining the length of a pendulum or an arc of the earth's circumference. The writer is informed by Mr. Whitworth that the standard cylindrical gauges supplied by him to engineering and other establishments do not vary 1-10,000th inch in diameter for any size up to 2 inches, and the larger sizes, up to 6 inches diameter, do not vary 1-5000 inch.

In consequence of the variation in the lengths of the several quadrants of the earth's circumference, a suggestion has been made by Sir John Herschel to adopt the earth's polar axis as the standard of reference, that being the only single or unique dimension of the earth's mass. As this dimension is very nearly 500,500,000 inches, or 1-1000th part more than 500 million inches, it has been proposed by him to increase the inch by 1-1000th part, and make it then the standard unit of length as the 1-500 millionth part of the earth's polar axis. It has to be observed, however, in reference to this proposal, that 1-1000th part of an inch is now an appreciable quantity in mechanical work, such as boring rifles, &c.; and the alteration, if carried out, would involve a loss of one mile in every 1000 miles. Moreover, independently of these practical objections, any such step would really involve a similar mistake to that made in originally fixing the metre, since the result of future more correct measurements of the earth's axis would be likely to require a correction in the fraction expressing the inch, in addition to the present known error of 1-170,000th part, arising from the actual length of the axis being rather less than 500,500,000 inches, as ascertained by the present measurement.

All these various considerations therefore appear to lead to the conclusion that the best practical course is to refer to an individual standard which will admit of being copied with a very high degree of accuracy, as in the case of the present legal standard in this country.

3rd. The next question, as to the standard best suited for use in decimal subdivision, is one to be determined by the relative practical convenience or inconvenience of the principal subdivisions and multiples of the different standards of length.

The old legal standard of measures in this country, the yard, is near the size of the metre, the former being 36 inches and the latter 39·3708 inches. If the yard were subdivided decimally into tenths, hundredths, and thousandths, it would make a scale as inconvenient and difficult of application in this country as the metre scale: but the standard is defined as a yard of 36 inches, and the inch, as a unit of measure, has important advantages as regards facility of application, and has a special qualification for the purpose as a convenient unit for expressing the smaller dimensions required in mechanical engineering work, since the subdivisions and multiples of the inch predominate in the dimen-

sions of the parts of machinery, &c. For example, a measuring machine extending from 0 to 10 inches gives an ample range to make the requisite templates and gauges with an accuracy up to 1-1000th inch for all the boring and turning work required for locomotives and for stationary engines up to 100 horse power, and for the tools and machines of corresponding size. The larger dimensions above 10 inches are but few in number as compared with those below 10 inches and are not required to be more accurate than to 1-100th inch; their dimensions can therefore be obtained from a steel rule of 100 inches length, divided into inches, tenths, and half-tenths; while the half-tenth of an inch, being easily divisible by the eye into five parts, gives hundredths of an inch. The writer has found such a range up to 100 inches amply sufficient for the requirements of one of the largest locomotive establishments, and also for all the purposes of a large ironworks: and with such a system great accuracy of work is obtained, mistakes and misfits are avoided, and a duplicate system of the most perfect kind is established.

For small dimensions the metre is divided into 1000 parts, called millimetres, each being equal to ·03937 inch, or about 1-26th inch: but in the classes of work in which the finer dimensions of thousandths of an inch are requirrd, the inch has an advantage over the meter in convenience of application as the unit of measure; for dimensions in thousandths of an inch are readily and coveniently expressed and spoken of, but with the metre as a unit such dimensions require the use of millimetres and fractions of millimetres carried to two places of decimals in order to express them. For example, the standard bore of the government rifles, in which a difference of 1-1000th inch in the diameter of bore has to be recognised and expressed, is

·577 inch or 577 thousandths;

but the expression of such a dimension on the metre system would be in the inconvenient form of

14·67 millimetres.

This is a practical advantage of importance in favour of the inch as the unit of measurement; for dimensions to 1-1000 inch are now required in regular use for various descriptions of work. For example, in the case of fixing a wheel or a lever upon its axle, the amount of difference in diameter required between boring and turning, in order to ensure the correct amount of tension, is not a thing to be guessed at, but is a definite quantity ranging from 1-1000th to 5-1000ths inch or ·001 to ·005 inch. If, in addition to forcing on by hydraulic pressure, as in the case of putting wheels upon their axles, the further step is taken of expanding the external portion by heat and then shrinking it upon its seating, as in fixing levers upon shafts, a very high degree of accuracy in the respective diameters is required, in order to ensure a definite amount of tension: this is especially the case in the manufacture of wrought-iron ordnance, where one series of hoops has to be shrunk upon another, each layer being compressed in proportion to the work it is intended to sustain. These dimensions of 1000ths inch are now readily appreciated and worked to in regular work by means of the system of contact gauges introduced by Mr. Whitworth; they can be measured by any good workman with a pair of callipers, and great advantage in accuracy and facility of work is derived from the system of working to these definite decimal dimensions.

It may also be observed that the inch divided into 1000ths serves very conveniently to express the series of thicknesses known as the wire and metal gauges, as shown in Mr. Whitworth's decimal wire gauge, extending from No. 300 or 300 thousandths of an inch to No. 18 or 18 thousandths of an inch.

A decimal scale founded on the inch as the unit would have then for its subdivisions the 100ths and 1000ths inch at present in use; and the first ascending step in the scale would be the substitution of a 10-inch foot for the present 12-inch foot, being a reduction of 1-6th in the present measure. The succeeding measures would be as shown in the following table, taking merely for the sake of comparison similar nomenclature to that of the metre scale:—

	Inches.				
Milli inch =	·001	or thousandth of an inch.			
Centi inch =	·01	,, hundredth ,,			
Deci inch =	·1	,, tenth ,,			
Inch =	1	the Standard Unit.			
Deca inch =	10		5-6th foot	of	12 inches.
Hecto inch =	100	about	1⅓ fathom	,,	72 ,,
Kilo inch =	1,000	,,	1¼ chain	,,	792 ,,
Myria inch =	10,000	,,	1¼ furlong	,,	7920 ,,
	100,000	,,	1⅗ mile	,,	63,360 ,,

A corresponding decimal scale applied to superficial measure would be as follows:—

	Sq. ins.				
Square inch =	1				
Square Deca inch =	100	about	2-3rds foot	of	144 square inches,
Square Hecto inch =	10,000	,,	¼ pole	,,	39,204 ,, ,,
Square Kilo inch =	1,000,000	,,	1-6th acre	,,	6,272,640 ,, ,,

In carrying out this change of the measures at present in use, it has to be observed that, in consequence of taking for the unit the lowest of the present denominations—the inch—the important advantage is obtained, that any dimension on the present system can be exactly expressed in the decimal system without any fractional remainder, and the only calculation required for the change is to bring the dimension into inches, which immediately gives its corresponding value in the decimal system. But if any other of the present measures, such as the foot or the yard, were taken as the unit, a troublesome calculation would be required for this purpose, just as in the case of adopting the metre for the unit; and the result would be an inconvenient fractional quantity, with its accuracy depending in many cases on the length to which the decimal was carried.

4th. The last consideration is the standard that is in most general use, and, consequently, involves the least alteration of existing measures in its adoption.

The metre was established in France in 1840, and is now the measure in use throughout France, Belgium, Holland, and Northern Italy. It has also come partly into use in Spain, Portugal, Italy, and Greece, and in Brazil, Peru, Chili, Mexico, and other countries in America.

The population of the above countries is about as follows, taking the data from the *Almanach de Gotha* :—

			Population.
Metre in use.........	France, Belgium, Holland, and Northern Italy,	....	50,000,000
Metre in partial use	European Countries.........	37,000,000	
	Ditto Colonies	35,000,000	
	American Countries	26,000,003	
			98,000,000
			148,000,000

The inch is in use throughout the British empire (excepting India), and in the North American States. In British India the native standard measure, the "hath," is legalised as 18 inches; and a multiple of the inch is also the standard measure of the Russian empire, the imperial "sagene" being legalised as 7 feet English. The population of the above countries is about as follows, taken from the same source :—

			Population.
Inch in use	British Empire (excepting India)................	36,000,000	
	North American States...	31,000,000	
			67,000,003
Multiple of inch in use.................	British India	138,000,000	
	Russian Empire	74,000,000	
			212,000,000
			279,000,000

In addition to this excess in the actual numbers of the people now using the inch over those now using the metre, the fact should be considered that the former include the great machinery producers, whose work is already existing in such large quantities in all parts of the world in the form of engines, machinery, railway plant, tools, &c.; such as the tools and machines of Manchester and Leeds, so largely exported to other countries, their cotton and flax machinery, the sugar mills of the West Indies, the steam engines, agricultural engines, and machinery sent to all parts of the world, steamboats, railway plant and machinery, railway bridges and roofs, &c. The amount of steam engines and machinery alone that has been exported from this country during the last twenty years having reached the value of £49,000,000, and averaging during the last five years about £4,000,000 annually. The large excess in the machinery already made under the inch over that made under the metre system of measure, is an important practical consideration, as it must be remembered that the machines sent out to other countries form types of other machines, and that they require repairing and renewing with the same measures with which they were made. In this country the inch is involved intimately in all mechanical engineering work, and is the basis on which the various machines and engines have been built—as the mechanical engineer may be said to think in inches, calculate in inches, and work in inches. Mechanical drawings are made to the inch or its multiples; patterns

are in inches; the pitches of the teeth of wheels, the sizes of taps and dies, the standard gauges for boring and turning, and the finer dimensions of every part of every tool, machine, and engine, are all made in inches; and the sizes of all bars of iron and planks of timber are in inches. The inch is also the basis of the data for calculations of strength of materials, sectional areas of girders and framing, pressure of steam, &c., power, velocity, capacity, and weight. The difficulty of effecting any change in the unit now forming the basis of these measures and calculations would therefore be exceedingly great; but in the case of the metre this difficulty is greatly increased by the relation between the metre and the inch requiring a long fraction to represent it with sufficient accuracy for such purposes, thus:—

1 metre is equal to 39·3708 inches, and
1 inch is equal to 25·3995 millimetres.

In the following table are shown, for the purpose of comparison, the corresponding values in millimetres of some of the ordinary fractions of the inch, and the corresponding values of square and cubic inches in square centimetres and cubic millimetres; from which will be seen the extreme difficulty and inconvenience that would arise in attempting to change the inch to the metre system:—

1	inch	=	25·3995	millimetres.
½	,,	=	12·6998	,,
¼	,,	=	6·3499	,,
1-8th	,,	=	3·1749	,,
1-16th	,,	=	1·5875	,,
1-32nd	,,	=	0·7937	,,
1-64th	,,	=	0·3968	,,
1-100th	,,	=	0·2540	,,
1	square inch	=	6·451	square centimetres.
10	,,	=	64·512	,,
1	cubic inch	=	16·386	cubic millimetres.
10	,,	=	163·862	,,

Considering the preponderance of the population now using the inch and not the metre, and the extent to which the inch is now spread over the whole world, the difficulties in the way of a change to the metre appear to the writer so great as to amount practically to a prohibition of a decimal system of measure if it is to be based on the metre.

The subject of decimalising the present very irregular and inconvenient system of Weights and Measures of Capacity in this country, is one of great importance; and great advantages would arise from their reduction to a uniform decimal system. It has been supposed that the metre system has an advantage in basing the system of weights directly upon the measures of length, the kilogramme of 2·2048 lbs. English being intended to be exactly the weight of a cubic decimetre of pure water at its maximum density; but it now appears, from subsequent more accurate measurement, that this requires some correction, so that the relation between the kilogramme and the metre is not an even one as intended, but an uneven fractional one. There is strictly no choice, therefore, in that respect between the kilogramme and the pound; and, in fact, in the same way as with the definition of the metre or the inch, any weight, such as the English pound, may be defined with equal accuracy for the standard unit.

It may be remarked that if the pound (pound avoirdupois = 7000 grains troy) were taken as the standard unit for decimal weights, the important weights of the cwt. and the ton, which now vary in practice, the cwt. between 112 and 120 lbs. and the ton between 20 and 21 cwts., or 2240 and 2520 lbs., might be decimalised as 100 and 2000 lbs. without any very serious difficulty, and with important advantage in removing another of the old irregularities in the system of weights and measures; just as, in 1841, the imperial and decimal gallon, consisting of 10 lbs. of distilled water at 62° Fahr., was substituted by Act of Parliament for the old ale and wine gallons, having 102 and 83 per cent. respectively of the same value.

The following are the general conclusions submitted in the present paper in reference to the standard for decimal measure:—

I.—That the inch and the metre are equally eligible for the purpose, as regards the basis of reference on which they are founded; and either of them could be as accurately and readily replaced as the other in case of being lost: since both of them are practically dependent upon the copying of an individual standard, which can be effected by the present improved means of measurement with a higher degree of accuracy than could be attained in a repetition of the original process of constructing the standard by reference to a natural standard, such as a pendulum or an arc of the earth's circumference.

II.—That the metre is not suitable for adoption in this country, on account of its entire difference from the existing measures, and the inconvenience that would arise in expressing the smaller dimensions extensively used in mechanical work, &c.; and that the inch is the most suitable measure for the purpose, on account of its being intimately involved in the present data for calculations and dimensions of mechanical work, &c., and from its convenience for expressing the smaller dimensions extensively used. That for larger dimensions the easiest and most convenient decimal change would be the adoption of a 10-inch measure, which would be a reduction of an even fraction of 1-6th from the present foot; and the longer measures being already multiples of the inch, the change would then be at least easier for their decimal adaptation to the inch than for their entire alteration to the metre standard.

III.—That it is very desirable that an alteration should be made in the present system of weights and measures of capacity, for reducing them both to decimal systems; and that these can be based as definitely and conveniently upon the inch as the standard of measure as upon the metre; and that it will be preferable to adopt for the standard a weight that is already in most common use in this country, such as the pound, without attempting to construct any new standard bearing a more simple relation to the decimal standard of length, but differing from all the existing weights.

The President said that a deputation had been sent to the present meeting from the International Decimal Association, and he hoped they would give their views upon the subject of the paper that had been read.

Mr. James Yates, as a Vice-President of the International Decimal Association, said he had been particularly gratified to find that the

views expressed in the paper coincided so fully with those of the Decimal Association, with regard to the value and practicability of the decimal system of measurement; there was, indeed, little difference of opinion excepting in the ultimate conclusion drawn as to the standard unit for decimal measure, for which the metre was considered by the Association the most eligible. There was no question that the mode of measurement hitherto used in this country was so irregular and inconvenient that it ought to be abandoned, and a uniform decimal system substituted for it; and the introduction of such a uniform system universally throughout the world would be attended with most important advantages, from the rapidly extending international communications. The two practical conditions affecting the choice of a universal standard unit of measure were, that it should be the one best suited for use in decimal subdivision; and that it should be the one causing the least possible alteration in the existing measures. The question was thus brought into a very narrow compass: namely, whether the preference should be given to the inch or to the metre as the unit of measure; the latter being defined by the platinum metre preserved since 1799 in the *Hotel des Archives* in Paris, and the former by the gun-metal yard measure or bar deposited in 1855 in the office of the Exchequer at Westminster.

The course adopted by the International Decimal Association, in order to obtain a solution of this question as to the best unit of length, had been to send a series of eleven questions to all the persons who were supposed to be best qualified to judge upon the subject; and the answers having been received, four meetings were held in London, to which all such persons were invited; and on that occasion Mr. Whitworth's system of accurate measurement was exhibited and explained. The result of the discussion of the question at the meetings was that a report was drawn up and circulated, in which it was recommended as eminently desirable that the unit of management should be of such a length as might be adapted to measure the greatest variety of objects, and in the most numerous cases likely to occur in daily life; and that it should be visible at a glance of the eye, and easily carried about and manipulated: and it appeared that for these purposes the inch or the foot would be too short, and the fathom too long; and that a measure of about the same length as the ell, the yard, the metre, or the second's pendulum was to be preferred, of which there were important reasons for selecting the metre as the universal unit. The inch, indeed, seemed at the outset very unsuitable to become the basis of a universal system; and although for English mechanical engineers it might be a very convenient measure, yet even for their purposes he was not satisfied that it would be better than the metre, by the use of which he thought all measurements in mechanical work might be made with equal nicety and accuracy. In the ordinary transactions of daily life the commonest and most universal measurements might be taken as those associated with textile manufactures; and the metre being a measure suitable for cases of this kind would be the most convenient for common use and most eligible as the standard unit of lineal measurement. For example, an order for 13 metres of silk or 64 square metres of carpet was simple in expression, and would convey a clear conception of the quantity, if the metre system were adopted, and the

unit would be very near the yard now used for the purpose; whereas, with the inch as the unit, the equivalent expressions of 510 inches length, or 99,000 square inches respectively were very inconvenient and not very easily conceived. Such illustrations showed clearly the inconvenience of using a small unit; and led to the conclusion that, in fixing a standard unit of measurement, it was necessary not to have regard to any special purpose exclusively. In aiming solely at the small measurements that predominated in mechanical engineering work, the inch might be the best; but when a standard was required for all sorts of measurement, the inch was, in his own opinion, unsuitable for general use.

For the purpose of minute subdivision every advantage was presented by the metre which was attainable by the inch; since the accuracy of minute measurements depended not on the scale, but on the instrument, which could of course be made equally applicable to any scale. The most recent instrument for minute measurements in connection with the metre system was that of M. Perreaux, of Paris, which was shown in the Great Exhibition of 1862, and afforded the means of measuring to 1-3000th of a millimetre (about 13 millionths of an inch); and for all practical purposes that was probably as minute and exact a measurement as was required. It should be remarked that Mr. Whitworth himself, who had recommended the inch to be adhered to for mechanical engineering work, objected to the prototype yard from which the inch was supposed to be taken, because it could not be seen or used; and had shown that it was hardly to be called a measure at all, and was inapplicable and of no value whatever in mechanical operations. The Astronomer Royal too had admitted that the chief value of this standard yard was its convenience for geodetic operations. For these purposes, however, the metre was at least equally eligible; and the difficulty that was anticipated from converting the present measures of this country to the metre system, on account of the number of decimal places required, would be met by the use of ready reckoners, specially adapted to all the purposes of commerce; these would be requisite until the metre was fully established in general use, after which the need of any such aids would cease.

With regard to the relative population in favour of the inch and the metre respectively, he believed the numbers given in the *Almanach de Gotha*, as the population at the present time of all the countries in the world, were generally accepted as the best authority on the subject; and from these data he had come to the conclusion that the population in favour of the metre should be taken as about three times that using the inch, instead of the majority being in favour of the inch, as argued in the paper. Russia, with a population of 74 millions, appeared to have been put down as favourable to the inch, because it used the "sagene" of 7 feet English or 84 inches. This measure, which was the Russian fathom, had been fixed at a time, when the length of that fathom was very uncertain, by Peter the Great, who decided that it should be exactly equal to 7 feet English. It had been stated, however, by Mr. Kupffer, the imperial superintendent of weights and measures in Russia, that although the inch was known in Russia, as the 1-84th part of their standard unit, it was not used by any means in the same manner or to the same extent as the inch was used in Eng-

land: on the other hand, he instanced many points, in which the present weights and measures in Russia approached very nearly to the metre system; and he expressed his opinion that it would be far easier for Russia to adopt the metre system than for England to do so, and he decidedly considered the metre system was preferable for Russia to the inch system. A report had also been presented to the Minister of Finance by the Imperial Academy of Sciences in St. Petersburg, in which the adoption of the metre was recommended for Russia; and there was therefore some ground for saying that Russia was decidedly tending to the adoption of the metre. The different states forming the Germanic Confederation had formerly been exceedingly confused in their weights and measures, and had recently appointed commissioners to devise a uniform system, who recommended the adoption of the metre system, throughout all Germany. A meeting of the several representatives was then held at Frankfort-on-the Maine, when all the states, except Prussia agreed to adopt the recommendation of the commissioners; and at length, in 1863, when the statistical congress was held in Berlin, Prussia also gave in its adherence to the metre system: thus all Germany might now be fairly reckoned on the side of the metre. Moreover, Germany had for a long time past made a partial use of the metre system, the half kilogramme having been employed as the standard unit of weight in the custom house, the post office, the railways, and other public departments. In India also there was a movement going on which was favourable to the metre system, and recent extracts from the *Madras Times* showed that that district of India was considering the subject and inclining to the metre. On the whole, therefore, he thought that Germany and Russia should be added on the side of the countries favourable to the metre, and India should at least be omitted from the number for the inch; and the population favourable to the metre would then be more than 200 millions, in comparison with about 70 millions actually using the inch at the present time.

An important movement was now going on in this country for introducing the metre system in education, since it was clear that the system could not be brought into universal use unless it was first taught universally in schools. He had found a widely prevalent desire on the part of schoolmasters and others interested in education to have the metre system taught in schools to all classes of the community, and it was astonishing to see the amount of facility with which the system was learnt. He exhibited a diagram of the measures and weights of the metre system (Dowling's synoptic table), by means of which he was confident any child might be made to understand the principles of the system thoroughly in a few hours; and if the system were taught for three months in any of the elementary schools, the children would become quite familiar with it. But on the other hand it was well known that the present confused tables of weights and measures were a continual torment to the learners, who had no sooner got them by heart than they began to forget them. The metre system, however, was not intended to be rendered compulsory in this country at present, but to be publicly taught and by that means gradually introduced, and not made compulsory until the nation was fully prepared for it.

He was happy to acknowledge the favourable opportunity that had been afforded by the paper just read for a practical discussion of the subject in one of its many important bearings; and such a course could not fail to contribute to the satisfactory settlement of this important international question.

MANCHESTER LITERARY AND PHILOSOPHICAL SOCIETY.

At an ordinary meeting of this Society, held October 3rd, 1865, a paper was read "*On the internal heat of the earth as a source of motive power*," by Mr. George Greaves, M.R.C.S., of which the following is an abstract:—

It has been very generally admitted that coal will not cease to be furnished because of the exhaustion of the stores of the mineral now existing in the coal measures; and further, that the obstacles to the continued working of the mines will not be engineering difficulties. The increased depth from which the coal will have to be brought may add to the cost, but at that increased cost it will still be for a long time obtainable. The author considered the real insurmountable obstacle to be the high temperature of the lower portions of the carboniferous strata. That temperature had been shown to be at a depth of 4000 feet at least 120° Fahr., a degree of heat in which human beings cannot exist for any length of time, much less use any exertion. It had occurred to the author to inquire whether the very agency which will prevent the continued supply of fossil fuel might not be made the means of rendering that supply unnecessary—whether, in short, the internal heat of the earth might not to some extent be utilised. One or two modes of doing this had presented themselves to his mind. One of these might, he conceived, be the direct production of steam power by bringing a supply of water from the surface in contact with the heated strata by means of artesian borings or otherwise.

On the 5th of October, Mr. A. Brothers, F.R.A.S., exhibited before the Photographic Section of the Society an interesting series of photographs, taken during the eclipse of the moon, on the evening of Wednesday, October 4th. Commencing at 8·45, when the moon was nearly full, the negatives, twenty in number, were taken at intervals of about twelve minutes until 12·45, and they show the progress of the eclipse throughout. The effect of the penumbral shadow of the earth is distinctly visible on the negative taken at 9·15, and also on the one taken 12·32. An attempt was made during the middle of the eclipse to obtain the photographic image of the entire surface of the moon; but it was found that the portion covered by the earth's shadow had no effect on the plate after an exposure of 15 seconds, although distinctly visible in the telescope. It was noticed that the southern limb of the moon showed the copper-coloured tint often seen during total lunar eclipses, and to this cause may be attributed the non-actinic

effect on the sensitized plate. An exposure of about one or two-tenths of a second gave the fully-illuminated surface of the moon perfectly, but the parts covered by the penumbra were not defined, while an exposure of three seconds gave the outline of the earth's shadow with great distinctness, and an exposure of two seconds brought out some of the detail within the penumbra. Some of the negatives were obtained almost instantaneously.

The telescope with which these pictures of the moon were taken is an equatorial of 5 inches aperture and 6 feet focal length, driven by clockwork. This telescope gives the image of the moon about 11-16ths of an inch in diameter, but by using a Barlow's lens this size is increased to 1¼ inch, and with this addition the eighteenth negative of the series was obtained in two seconds.

Dr. Joule, F.R.S., exhibited and explained the construction of a camera which he had contrived for outdoor work without a tent.

In this camera the operation was carried on by the successive introduction of the sensitizing and developing baths, the mode of the application of the baths being similar to that already described by the author. By a special arrangement the holders of the plate are preserved from contact with the developing solution.

At the ordinary meeting, October 17th, a paper was read, entitled "*Notes on the origin of several mechanical inventions, and their subsequent application to different purposes, by* J. C. Dyer, Esq., V.P."

I.—LACE-MAKING MACHINE.

The bobbin net trade at Nottingham had been carried on by women working on cushions or lace frames until about the beginning of this century, when the process was superseded by the lace-making machine invented by the late Mr. John Heathcoat, M.P. Mr. Heathcoat commenced his experiments by stretching common packing threads across his room for the *warp*, and then passing, by common plyers, the weft threads between the cords, delivering them into other plyers on the opposite side, and then, after giving them a sideways motion, repassing the threads back between the next adjoining cords, and thus effecting the intersecting or tying of the meshes in the same way as they were formed on the cushions worked by hand. His next step was to provide thin metallic discs to be used as "bobbins" for conducting the thread back and forth through the warp. These discs being arranged in carrier frames, placed on each side of the warps, were moved by suitable machinery, so as to conduct the threads from side to side, to form the lace. The limits of this abstract do not allow any detailed description of Mr. Heathcoat's beautiful invention; its effect, however, in superseding the hand work appears to have led to the Nottingham riots and the lace frame breaking, which took place about fifty years ago, when Mr. Heathcoat removed to Tiverton in Devonshire, where the patent lace-making was re-established, and has been since carried on upon a large scale, and has thus proved an eminently successful invention.

The new principle of action conceived by Mr. Heathcoat was that of passing the threads of the weft through those of the warp, and delivering them into conductors on the other side, to be repassed and

delivered into the former conductors under mechanical control, in place of hand working. He succeeded in working out this principle with marvellous perseverance and success, and this original conception of Mr. Heathcoat opened a new vista to other eminent mechanics, which led to the invention of many other valuable machines for widely different purposes, among which may be named that for passing back and forth the threads through fabrics for embroidering, as now exhibited in the beautiful machines for embroidering or ornamenting fabrics in the works of Messrs. Houldsworth. On the same principle is also based the cotton combing process now employed for separating the short and coarse from the long staples in fine cotton carding.

II.—WIRE CARD MAKING MACHINE.

About the beginning of this century Mr. Amos Whitimore, of Boston, commenced his experiments for making cards by machinery. His first step was to examine the movements required to form and set card teeth for hand carding. He was for a long time engaged with trial machines, and ultimately succeeded in performing the operations for making and setting the card teeth by movements effected by excentrics on a driving shaft, viz. (1) feeding the wire, (2) holding it, (3) cutting off and (4) bending the wires into staples, (5) piercing holes in the leather, (6) passing the staples through it, (7) pressing their crowns to the sheet, (8) crooking the teeth to the knee bend, and (9) advancing the leather to receive the next row of teeth. These complex and curious motions were effected by a series of cams or excentric pieces fixed on the shaft and turned by a winch; therefore the invention of making wire cards by machinery was accomplished by Amos Whitimore, but it was many years thereafter before his machine could be made profitable in competing with the hand card makers.

The final development of this invention is explained at large in the paper, but cannot be given in this abstract. In this machine, as in that of Mr. Heathcoat's, a new principle of action was adopted to produce and govern the movements for making wire cards, viz., that of excentric curves, revolving on a driving shaft and guiding the motions of the traversing parts of the machines in their due order of succession for making and setting the card teeth as before stated. This application of curvilinear projections or cam pieces has since been extensively employed for giving intricate motions in many other machines invented during the last fifty years. Whence it appears that both Mr. Heathcoat and Mr. Whitimore became pioneers and guides to other able mechanicians in their labours for the advance of mechanical science.

Among the inventions based upon that of the carding machine may be mentioned the machine for making the eyes or shanks of metal buttons, the machine for making wire reeds for weaving, and that for making pins. But without dwelling on other instances, it will suffice to say that the success of the lace machine and that of the wire card machine serve to spread the seeds of knowledge in practical mechanics, the germs of which, half a century ago, were widely cast forth from the fertile geniuses of John Heathcoat and Amos Whitimore.

III.—CUTTING FURS FROM PELT.

In the year 1810, a model fur cutting machine was sent to me in London by a company in Boston, to be patented in England. It was

stated to be the invention of a Mr. Bellows, who was unknown to me. The machine was adapted for shearing fibres from surfaces by the action of spiral cutters revolving and acting against a fixed straight cutter, so as to shear or cut fibres from the surfaces to which they are attached. I had a machine made and put into operation at a hat manufactory in the Borough; but the workpeople opposed its being used, which discouraged further attempts to bring it into use in that trade. The principle of it, however, was soon after patented for chopping, straw, roots, &c., for which it was found valuable. Two or three patents were afterwards taken out for shearing the nap from cloth by the same action of spiral cutters revolving against a straight fixed edge, and many others have since appeared on the same principle, among which is that for mowing lawns.

SELECTED PAPERS READ AT THE RECENT MEETING OF THE BRITISH ASSOCIATION AT BIRMINGHAM.

"On some developments of, and improvements in, Giffard's injector," by Mr. J. Robinson.

Having referred to the difference of opinion existing among engineers as to this, which had been called by the President, somewhat paradoxical instrument, the paper described the action of the injector to be as follows:—Steam was taken from the steam space of any boiler by means of the injector, the water supply was brought into contact with the steam current, and the result in the shape of hot water was passed into the water space of the boiler. The question was, how, having an equal pressure on all parts of the boiler, did a fluid not only pass in the shape of a current from one part to another, but at the same time carry with it another fluid exposed to atmospheric pressure only. Having described the construction of the injector, the paper pointed out the importance of an apparatus capable of supplying water to steam boilers without motion of any of its parts, and independent of the engine connected with it. It had proved almost essential to some particular arrangements of boilers and engines. For locomotives, the advantage had been very considerable, inasmuch as it was most important that the machinery of engines running at such high velocity should be free from the apparatus and repairs necessary when their boilers were fed by pumps worked by the engine. The advantage, also, was obtained, of feeding the boiler while the locomotive was at rest, either in the station or during its retention, in a siding, waiting for the line to be cleared. For this purpose, 5230 of the injectors had been manufactured in this country. For stationary boilers the injector had been found convenient, because of the saving of the pipes and other communication from the boiler to the engine room, the suppression of the pumps and the parts of the engine necessary to work them, and the advantage of being able to fill up the boilers during meal hours, and at other times when the engine was stopped. For this purpose, 3816 had been made in this country. For marine boilers the apparatus was most convenient, since it answered generally the purpose both of the main engine pumps and of the donkey pumps, and brought the control of the feeding apparatus within reach of the stokers, without reference to the engine room, and without the noise and complication of the donkey pump. In the com-

plete form, and also in the ordinary injector arrangements, the principle had been applied for raising water from mines and wells, the inducement being the cheapness and simplicity of the apparatus, and the small space and easy manipulation required. The paper proceeded to describe improvements which had been made upon the injector as it first came from the hand of the inventor.

"On Siemen's regenerative gas furnaces and producers," by Mr. S. N. F. Cox.

The paper opened by stating that the system of regenerative gas furnaces having now been before the manufacturing world for several years, and employed for the manufacture of glass of all kinds, of iron and steel, and nearly every other article in the production of which great heat was employed, and having proved in nearly every case successful, it had ceased to be an experimental system, and had become an established and recognised success. The paper then described, by the aid of diagrams, the construction of the furnace in which the gas was burnt, and the gas-producer for all descriptions of fuel, except binding coal, the method adopted for making the gas, and then the binding coal producer, and the nature of the fuel. By the process, a flame was obtained (equal to a white heat) which contained nothing that could injuriously affect the most delicate manufacture, for even sulphuring was prevented; for the sulphur in separating from its hydrogen took up oxygen supplied by the carbonic acid and water, forming sulphurous acid, a firm compound, which was not decomposed on meeting metallic oxides in the furnace. The nature and intensity of the flame was also under the instant control of the man in charge of the furnace, so that the chemical nature of the flame could be altered at will—one minute an oxidising flame being obtained, and the next a reducing or carbonising one. So also the amount of the flame could be altered from the smallest flicker to the complete filling of the chamber with an intense body of flame. The paper pointed out the immense advantage thus obtained in furnaces where the delicate operation of heating or melting steel was carried on; and hence a great number of influential firms were now adopting the furnaces in England for re-heating purposes, especially for re-heating steel blooms and ingots. The paper contained statements from firms using the furnace, stating the favourable results of their experiments. It pointed out that the advantages of the system were, first, an immense saving of fuel. A ton of steel by the furnace was melted with an average weight of a ton of coal, instead of two and a half to three tons of coke, which represented six to seven tons of best coal. With such names before them as Meyer, Borsig, and Krupp, as employers of Siemen's furnaces for steel melting, it did little credit to our English enterprise to say that there was hardly one furnace in England in constant work for steel melting. Besides the saving of fuel there were other advantages in the working of the furnace, such as cleanliness, no solid fuel being brought into the shop where the furnaces were, the fuel being converted into gas at any convenient distance from the furnaces; compactness of arrangement, saving of labour, and, above all, improvement in the processes themselves. In every trade in which the furnace might be employed, the same advantages were apparent; and though the furnaces were costly, and required a large outlay at first, especially in old works, they soon paid for themselves.

Provisional Protection Granted.

1865.

[*Cases in which a Full Specification has been deposited.*]

2344. Joseph Page Woodbury, of Boston, U.S.A., a locomotive car.
2349. Sigourney Wales, of Massachusetts, an invention having reference to windows or the sashes thereof.

The above bear date September 13th.

2380. George Augustus Keene, of Newburyport, impd. feathering paddle-wheel.—*September 18th.*
2421. Walker Moseley, of King-street, Covent-garden, impd. indicator for electric bells and a new battery manipulator combined, for ringing electric bells and other signals.—*September 22nd.*
2429. Henri Adrien Bonneville, of Paris, impts. in apparatus for lubricating machinery,—a communication.
2436. Thomas Vincent Lee, of Macclesfield, impts. in preparing peat or turf for fire lights and fuel, and for machinery to be employed therein.

The above bear date September 23rd.

2488. William Ellis Metford, of Taunton, impts. in rifling fire-arms, and in missiles or projectiles used in such, and in the machinery for the production of these impts.—*September 28th.*
2509. James Austin Mee, of Failsworth, near Manchester, impts. in telegraphic cables.—*September 30th.*
2585. Henri Adrien Bonneville, of Paris, impts. in apparatus for preparing skins for tanning, and for currying or dressing the same,—a communication.—*October 7th.*
2627. Vernon Augustus Messinger and Virgil Jackson Messinger, of Boston, U.S.A., impts. in shirt collars and bosoms,—a communication.—*October 12th.*

Cases in which a Provisional Specification has been deposited.

1431. Jules Xavier Joseph Barbaix, of Bonnines, Belgium, impts. in brakes for railway carriages.—*May 25th.*
1509. Thomas Edwin Wright, of Birmingham, impts. on Bourdon's steam pressure gauge.—*June 1st.*
1531. Charles de Bergue, of the Strand, impts. in apparatus for the manufacture of rivets.—*June 5th.*
1555. Victor Duterne, of Paris, impd. metallic stuffing box.—*June 7th.*
1618. Virgile Poitevin, of Saint Denis, near Paris, impd. method of propelling agricultural implements.—*June 15th.*
1645. Charles Hook and Alfred Peace, of Bridgewater, impts. in propellers for ships and other vessels.—*June 19th.*
1664. John Busfield and Samuel Bairstow Walmsley, of Bradford, Yorkshire, impts. in machinery for combing wool and other fibrous materials.—*June 21st.*
1710. Henry Shaw, of Lorrimore-square, Walworth, impts. in the means of, and apparatus for, retarding the velocity of the wheels of railway and other carriages when in motion.—*June 27th.*
1736. Patrick Denis Finnigan, of Camberwell-road, impts. in the means applied for arresting and stopping the motion of locomotive engines, trains, carriages, and other rolling stock of railways.—*June 30th.*
1775. John Longbottom, of Leeds, and Abraham Longbottom, of Hammersmith, impd. combination of materials for the manufacture of carpets, floorcloth, felt, wall paper, fire-proof flexible roofing, ship and boat building, and for other similar purposes.—*July 5th.*
1832. Hector Auguste Dufrené, of Paris, impts. in obtaining motive power,—a communication.—*July 11th.*
1884. George Nimmo, of Jersey City, U.S.A., impts. in the manufacture

of pots and crucibles, wherein metals and other materials may be heated or melted.—*July* 19*th*.

1916. Samuel Boyd, of the City, impd. cotton press.—*July* 22*nd*.

1950. Thomas Brown, of Dagmar-road, South Hackney, impts. in tea and coffee pots and urns.—*July* 27*th*.

2008. John William Perkins, of Norfolk-street, Strand, impts. in the treatment of hydro-carbon or paraffin oils.—*August 3rd*.

2010. Peter Cato, of Brunswick Dock, Liverpool, impts. in iron knees and riders for ships' fastenings, and iron frames for wood and iron ships.—*August 3rd*.

2018. Ephraim Sabel, of Moorgate-street, impts. in machinery to be used in the manufacture of iron,—a communication.

2029. Henry Adrien Bonneville, of Paris, impts. in checking or controlling the payment of fares in cabs and other public vehicles,—a communication.

The above bear date August 4*th*.

2039. John Petrie, jun., of Rochdale, impts. in machinery or apparatus for washing wool and other fibrous materials.—*August 5th*.

2046. William Crosher and George Crosher, of Ann-street, Wilmot-square, impd. manufacture of scarfs, cravats, and ties.—*August 7th*.

2064. Charles West, of Queen's-place, Kennington-road, apparatus for giving immediate warning of undue heat, whether occasioned by fire, spontaneous combustion, or any other causes; of leakage in ships, and of the sudden irruption of water, and the accumulation of choke damp in mines.

2074. Chauncey Orrin Crosby, of New Haven, U.S.A., impts. in machinery or apparatus for the manufacture of needles.—*August* 10*th*.

2082. Richard Douglas Morgan, of Hay, Brecon, impts. in the couplings or fastenings of railway carriages or trucks.

2088. Henry Robert Guy, of London-street, London, impts. in the construction of submarine telegraph cables.

The above bear date August 11*th*.

2120. Samuel Parry, of Leadenhall-street, impd. composition for coating iron or wooden ships' bottoms.—*August* 16*th*.

2126. Richard Archibald Brooman, of Fleet-street, impts. in washing fabrics and threads, and in machinery employed therein,—a communication.—*August* 17*th*.

2131. Richard Clarke, of Altrincham, Cheshire, impd. application of imitation embroidery to be employed for the ornamentation of crinolines.

2132. Matthew Cartwright, of Tavistock-street, and Augustus Dale, of Castle-road, Kentish-town, impts. in applying elastic material to boots, shoes, and such like coverings for the feet.

2134. Josiah Latimer Clark, of Beechmont, Sydenham-hill, impts. in apparatus for raising and recovering submerged telegraph cables.

2137. Richard Archibald Brooman, of Fleet-street, impts. in the manufacture of cast steel and cast iron, and the manufacture of a mixed metal,—a communication.

2140. Alexander Watt, of Ash Cottage, Putney, impts. in soap.

The above bear date August 18*th*.

2142. Isaac Bernhard, of Paris, impts. in the manufacture of artificial saltpetre,—a communication.

2148. John Edwin Marsh, of Birmingham, impts. in punkahs.

The above bear date August 19*th*.

2152. John Bowden, of Mitcham, impts. in blacksmiths' bellows, more especially those used in portable forges.

2154. William Shakespear, of St. Pancras, impts. in apparatus or mechanism for stopping or retarding railway trains.

The above bear date August 21*st*.

2164. George Little, of Oldham, impts. in machinery for combing cotton, wool, and other fibrous materials.

2169. Daniel Macpherson, of Edinburgh, impts. in sewing machines.

2172. John Garrett Tongue, of Southampton-buildings, impts. in apparatus for clipping horses or other animals,—a communication.

The above bear date August 23*rd*.

2180. Joseph Ingall Barber, of Shef-

field, impts. in skates,—a communication.

2184. Edwin Augustus Curley, of Amwell-street, Clerkenwell, impts. in apparatus by means of which certain liquids, common air, and certain elastic fluids, are made available in the production of light, and their quantity regulated and measured; parts of which impts. are applicable for other purposes.

2186. George Owen, of Compton-terrace, Islington, impts. in copying presses, for copying letters and other written documents.

The above bear date August 25th.

2196. François Antoine Edmund Guironnet de Massas, of Hoxton, impts. in machinery for treating cotton seeds in order to remove the cotton therefrom, and to prepare the seeds for crushing.—*August 26th.*

2208. Henri Adrien Bonneville, of Paris, impts. in the construction of flying toys; also applicable to other purposes,—a communication.

2210. Prosper Polain, of Liege, impts. in breech-loading revolvers.

The above bear date August 28th.

2214. Robert Thomas Holmes, of Kingsland Brewery, impts. in machinery or apparatus for disengaging runaway horses from carriages and stopping them, so as to prevent accidents.

2217. Richard Laming, of Priory-road, Kilburn, impts. in electrical telegraphy.

2218. Geminiano Zanni, of Rathbone-place, impts. in applying motive-power to sewing machines, for the purpose of rendering them self-acting.

2219. Hull Terrell, of Basinghall-street, and Thomas Don, of Alpha-road, New Cross, impts. in the method of, and apparatus for, treating peat and other plastic materials.

The above bear date August 29th.

2226. William Brookes, of Chancery-lane, impd. system of constructing cast and other iron bridges, viaducts, and other similar structures,—a communication.

2237. Michael Judge, of Toronto, manufacture of boiler and tea kettle bottoms, and every description of die-struck hollow ware.

2238. Edward Coupe and David Hancock, of High Wycombe, Bucks, impd. method of, and apparatus for, applying electro-magnetism in a break power on railways.—*August 31st.*

2239. Matthew Woodifield, of York-chambers, Adelphi, impd. apparatus for carrying securely railway and other tickets, so as to afford a ready inspection thereof.

2240. William Carron, of Birmingham, impts. in the manufacture of screws.

2241. William Henry Brown, of Sheffield, impts. in the manufacture of cast-steel or other metallic tubes.

2242. William George, of Liverpool, impts. in applying springs to two-wheeled carriages, to prevent the unpleasant jolting motion of the draught animal attached thereto being communicated to the body of the vehicle.

2243. George Smeaton, of Birkenhead, impts. in apparatus for cleaning the outsides of windows from the interior.

2244. Henry Clarke Ash, of Lupus-street, Pimlico, impts. in ice safes.

2246. William Thomas Read, of Great Saint Helen's, impts. in apparatus for stopping bottles.

2247. William Edward Newton, of Chancery-lane, impts. in obtaining spirits of turpentine, rosin, pitch, tar, pyroligneous acid, and other products from wood,—a communication.

2248. William Edward Newton, of Chancery-lane, impts. in the manufacture of paper pulp,—a communication.

2249. John Ward, of Leicester, impts. in the construction of lids or covers for saucepans and other cooking utensils; part of which impts. is also applicable to the lids or covers of housemaids' pails.

2250. John Ward, of Leicester, impts. in the means of fixing or attaching the bobbins of winding and other machines on to their spindles, which impts. are also applicable to other similar or analogous purposes, and to the detaching of railway carriages from trains whilst in motion.

2251. James Leslie, of Manchester,

impts. in cutting the terry or loops of fustians, cords, and similar fabrics; which are also applicable to cutting velvets.

The above bear date August 31st.

2252. Thomas Lomas, of North Shields, impts. in the separation of sulphide of iron from coal and carbonaceous matter.

2253. Robert Knowles and Joseph Lindley, of Manchester, impts. in ornamenting and protecting the edges of bed quilts, counterpanes, toilet covers, carriage rugs, and other similar coverings, by edging. binding, or fringing by machinery.

2254. John Money Carter, of Monmouth, impts. in shirts and other like garments.

2255. Alfred Vincent Newton, of Chancery-lane, impd. steam-heating apparatus,—a communication.

2256. William Clark, of Chancery-lane, impts. in the permanent way of railways,—a communication.

2257. William Clark, of Chancery-lane, impts. in laying and maintaining submarine telegraph cables, and in apparatus connected therewith,—a communication.

2258. Richard Davies, of Green Neath, Glamorganshire, impts. in propellers for ships and boats.

2259. Charles Horsley, of Wharf-road, City-road, impts. in meters or apparatus for measuring water or other fluids; partly applicable for exhausting air or other gases.

The above bear date September 1st.

2261. Joseph Sproul, of New Barnet, impd. method of laying or submerging ocean telegraph cables.

2262. Kirwan Joyce Perceval, of Belgrave-street, impd. means or apparatus to be used in laying telegraph cables in the sea or other deep waters.

2263. Jabez Elverson, of Newark, New Jersey, U.S.A., impts. in apparatus for sawing curved designs.

2264. William Barford, of Peterborough, and Thomas Perkins, of Hitchin, impts. in mills for grinding of the description known as Felton's American mill.

2265. Samuel Chatwood, of Bolton, impts. in the manufacture of metallic safes and strong rooms, and in apparatus connected therewith.

2266. Constant Reichen, of Lincoln's-inn-fields, impts. in preparing charges for fire-arms and for blasting.

2267. Henry Ellis, of Bangor, impts. in the manufaucture of compounds of silica, and in the production of silicated alkaline inks, colors, and dyes.

The above bear date September 2nd.

2268. Samuel Richards Freeman and Abraham Grundy, of Manchester, shackle or coupling for connecting railway carriages, waggons, and other vehicles, used on railroads, whereby going between the carriages, waggons, or other vehicles, to couple or uncouple, is rendered unnecessary.

2269. Joseph Drabble, of Southwark-bridge-road, impts. in apparatus used for removing axle boxes from wheels.

2271. Pierre Marvaud, of Paris, impd. apparatus for promptly disconnecting horses from carriages and other vehicles.

2272. James Howard, William Stafford, and William Porter McCallum, all of Blackburn, impts. in apparatus for preventing incrustation in steam boilers, and for preventing explosion of such boilers heating the feed water, and consuming smoke.

2273. Alfred Vincent Newton, of Chancery-lane, impts. in life rafts and surf boats,—a communication.

2274. Richard Archibald Brooman, of Fleet-street, impd. method of winding up watches and other time-keepers,—a communication.

The above bear date September 4th.

2275. Jacob Snider, junior, of Sullivan County, Pennsylvania, U.S.A., impts. in the construction of fire-arms; such improvements being also applicable to the alteration and adaptation of parts of existing fire-arms.

2277. Julien Grand, of Oullins, Rhone, France, impts. in treating, working, or manipulating cast-steel for the manufacture of wheel tyres, armour-plates, or other articles requiring great hardness and tensile strength.

2278. Joseph Neat and Francis Ford, of Southampton, impts. in hair-brushing machinery or apparatus.

2279. Thomas Thompson Ponsonby, of John-street, Kingsland-road, impts in ornamenting and surfacing veneers and other articles of wood.
2280. Thomas Bird Bailey, of Cheltenham, impts. in the ornamentation of fringes and trimmings.
2281. William Bunger, of Southampton-buildings, impts. in vessels or apparatus for melting sealing wax, glue, or other substances,—a communication.

The above bear date September 5th.

2282. Henry Harrison Doty, of Regent-street, impts. in machines for splitting, shaving, and paring hides, skins, and leather.
2283. Louis Gachin, of Hatton-garden, impd. method of, and apparatus for, heating instruments or irons for curling, waving, and frizzling hair, and for other purposes to which heated instruments or irons are applicable,—a communication.
2284. Samuel Soutar, of Turnham-green, impd. method of fixing and unfixing the tubes of steam boilers, —a communication.
2285. James Pilkington, of Bolton, impts. in preparing and spinning cotton and other fibrous materials.
2286. William Clark, of Chancery-lane, impts. in steam engines and valves,—a communication.
2287. Robert Allee Purkis, of Portswood, near Southampton, and George Callaway, of Selwood-terrace, Brompton, impts. in sewing or stitching machines.
2288. William Mycock, of Compstall, near Stockport, impts. in apparatus for lubricating shafts and other running surfaces.
2289. Thomas Nicholson, of Gateshead, Durham, impd. process of, and apparatus for, making caustic liquor or caustic lees.
2290. Thomas Charles Gibson, of Stamford, impd. machinery for mixing or grinding ointment, paints, drugs, and other substances.
2291. Edward Green and Edward Green the younger, of Wakefield, Yorkshire, impts. in boilers and furnaces, and in cleansing the flues thereof.

The above bear date September 6th.

2294. John Matthias Hart, of Cheapside, impts. in the construction of iron safes, strong boxes, and other receptacles.
2295. John Smith, of High Crompton, near Oldham, impts. in looms for weaving.
2296. James Dawson, of Greenock, N.B., impts. in supplying charcoal to sugar-decolorizing vessels, and in apparatus therefor.
2297. William Oldham, of Leeds, impts. in machinery for winding yarn cops.
2298. Abel Duvernois, of Paris, impd. fireplace, with turning grate.
2299. Augustin Morel, of Roubaix, France, impts. in machinery for combing wool and other fibrous material.
2300. William Lloyd Wise, of the Adelphi, impts. in machinery or apparatus for hulling and winnowing grain,—a communication.
2301. John Askew, of Charles-street, Hampstead-road, impts. in apparatus for stoning raisins.
2302. William Cory, of the Coal Exchange, and John Henry Adams, C.E., of Campbell-road, Bow-road, impts. in floating vessels and apparatus used for unloading vessels containing coals, corn, or grain.

The above bear date September 7th.

2303. Alexander Mackie and James Proctor Jones, of Warrington, impts. in machinery or apparatus for composing or setting type for printing.
2304. John Weems and William Weems, of Johnstone, Renfrew, N.B., impts. in the construction of hydrostatic presses.
2305. James Webster, of Birmingham, impts. in hydropults and hydrostatic pumps.
2306. John Walker, of Cowper-street, City-road, impts. in mounting and working guns in ships, forts, and batteries.

The above bear date September 8th.

2307. William Unwin, of Sheffield, impts. in the manufacture of iron.
2308. Alexander Mackie and James Paterson, of Warrington, impts. in the method of lighting gas, and in apparatus connected therewith.
2309. John Anderson, of Glasgow,

impts. in apparatus for signalling and indicating on railways.

2310. John Brigham and Richard Bickerton, of Berwick-on-Tweed, impts. in reaping and mowing machines.

2311. Henry Shanks, of Bridge-of-Weir, Renfrew, N.B., impts. in the winding of knitting cotton, and in the apparatus employed therefor.

2312. William Edward Newton, of Chancery-lane, impts. in machinery for making lace,—a communication.

2313. John Hose, of Leicester, impd. wheel feed for sewing machines.

2316. Richard Percy Roberts, of Kennington-park-road, impts. in cleansing and coating the bottoms of ships and other submerged surfaces, to prevent oxidation and the adhesion of marine animals and plants, also in compositions to be employed for these purposes.

2317. Richard Charles Newbery, of the Steam Works, Helmet-row, impts. in articles of wearing apparel.

2318. Adolf Erik Nordenskiöld and John William Smitt, of Stockholm, impts. in apparatus connected with safes for protecting valuables from fire.

2319. John Pennington, of Dulwich, impts. in apparatus used in opening and closing carriage and other windows.

The above bear date September 9th.

2320. Samuel Davis, of the Strand, impd. stirrup latch bar.

2321. William Tyne, Stephen Tyne, and Robert Clayton, of Bradford, impd. mode of removing and preventing the incrustation of steam boilers.

2323. Henry Hackett, of Warrington, and Thomas Wrigley and Edmund Pearson, of Manchester, impd. safety valve for steam boilers.

2324. Charles Thomas Burgess, of Newgate-street, impts. in reaping machines.

2325. Charles Ambrose McEvoy, of Bedford-square, impts. in pipes used for smoking.

2326. Samuel Inkpen, of Bartholomew-terrace, Cambridge-road, Mile-end, impts. in covering submarine telegraph cables, and in the machinery and means employed for paying out or hauling in the same.

2327. John Lightfoot, of Accrington, impts. in dyeing and printing fabrics, yarns, animal, or mixed animal and vegetable substances.

2328. Charles Huntley, of Hackney-wick, impts. in cricket, racket, tennis, and foot balls.

2329. Charles James Webb, of Randals Town, Antrim, Ireland, impts. in means and apparatus applicable to the lighting and reviving of fires.

The above bear date September 11th.

2330. David Keys, of Craven-street, Strand, impts. in watches, and in the method of, and apparatus for, winding up fusee watches and pocket chronometers and setting the hands without a key.

2331. John Badger and John Henry Steff, of Worcester, impts. in the manufacture of harrows, cultivators, and other similar agricultural implements.

2332. John Macintosh, of North-bank, Regent's-park, impts. in constructing and insulating telegraphic conductors, and in apparatus connected therewith.

2333. George Tangye, of Birmingham, and Joseph Jewsbury, of Kinver, Staffordshire, impts. in pulleys for raising and lowering heavy bodies.

2334. Joseph Welch, of Redditch, impts. in the manufacture of swivels.

2335. John Holliday, of Huddersfield, impts. in preparing certain coloring matters.

2337. William Jeremiah Murphy, of Cork, impd. hydraulic brake for railway and other purposes.

2338. Robert Andrew Boyd, of Duke-street, Southwark, impts. in cooling bacon-curing rooms or chambers.

The above bear date September 12th.

2339. James Dunbar, of Westminster Chambers, Victoria-street, impts. in the construction of boots and shoes.

2340. James Dunbar, of Westminster-chambers, Victoria-street, and James William Butler, of Dunmow, impd. apparatus for the distribution of perfumes, disinfecting, or other fluids.

2341. John Oliver Chapman Phillips, of Birmingham, impts. in the construction of submarine telegraph cables.

2342. John Dodd, of Oldham, impts. in mules for spinning and doubling.

2343. Alfred Vincent Newton, of Chancery-lane, impts. in spinning frames,—a communication.

2345. Frederick Waller Prince, of Piccadilly, impts. in breech-loading fire-arms and cartridges.

2346. Samuel Soutar, of Turnham-green, impd. apparatus for cleaning the tubes of steam boilers,—a communication.

2347. David Hyam and John Hyam, of Houndsditch, impd. fastening for purses and other like articles,—a communication.

The above bear date September 13th.

2350. Thomas Bell and Thomas Lesslie Gregson Bell, of Plaistow, impts. in apparatus used for calcining and roasting copper and other ores and substances containing sulphur.

2351. Gustavus Palmer Harding, of Chiswick, impts. in the manufacture of tubes for gun barrels and other purposes; parts of which improvements are also applicable to the manufacture of rods or bars, and to the rifling of ordnance and fire-arms.

2352. Isaac Beamish, of Leadenhall-street, impts. in lubricating apparatus.

2353. John Lewis, of Preston, impts. in machinery for making rivets, spikes, screw blanks, bolts, nuts, and other such like articles.

2354. Wilmot Burrows Edward Ellis, of Cheltenham, impd. form of rifling for fire-arms and ordnance.

2355. John Wakefield, of Birmingham, impts. in machinery for the manufacture of rivets.

2356. William Clark, of Chancery-lane, impts. in magnetic telegraphs,—a communication.

The above bear date September 14th.

2357. Louis Gustave Sourzac and Louis Bombail, of Bordeaux, impd. means of rendering leather more durable and flexible.

2358. John Whitehouse, of Tipton, impts. in the manufacture of box-irons.

2359. Edward Thornton Read, of Ardrishaig, Argyle,N.B., impts. in apparatus for cutting tobacco.

2360. Richard Archibald Brooman, of Fleet-street, impts. in locks for trunks, bags, dressing-cases, and other like articles,—a communication.

2362. Saul Myers, of Liverpool, impts. in smoking pipes and cigar holders, and an impd. tobacco cartridge to be used with the same,—a communication.

2363. Alfred Vincent Newton, of Chancery-lane, impd. machinery for cutting stone,—a communication.

2364. Henry Law, of Essex-street, Strand, impts. in caissons for closing the entrances of docks and canals.

2365. Robert Mann Lowne, of Bartlett's-buildings, impts. in vent pegs for casks or vessels from which beer or other liquid is drawn off from time to time.

2366. William Clark, of Chancery-lane, impts. in saddles and harness,—a communication.

2367. Frederick Meyer, of Paradise-street, Lambeth, and Joseph William Freestone, of Ram's-square, Wandsworth, impts. in the manufacture of night lights, and in apparatus employed therein.

The above bear date September 15th.

2369. Henri Adrien Bonneville, of Paris, impts. in save-alls,—a communication.

2371. John Henry Johnson, of Lincoln's-inn-fields, impts. in machinery or apparatus for shaping metal articles,—a communication.

The above bear date September 16th.

2374. Angelo James Sedley, of Conduit-street, impts. in paddle-wheel propellers.

2375. Michael Henry, of Fleet-street, impts. in railway breaks,—a communication.

2376. Francesco Daina, of Bergame, Italy, method of, and apparatus for, condensing the steam of steam engines.

2377. Oliver Weldon Jeyes, of Leyton, Essex, impd. method of making effervescing drinks.

2378. Henry Venables, of Newcastle-under-Lyne, impd. method of ornamenting the surfaces of tiles.

2379. Russel Aitken, of Great George-street, Westminster, impts. in loco-

motive engines; parts of which improvements are also applicable to railway carriages.

2381. Alfred Vincent Newton, of Chancery-lane, impd. construction of projectile,—a communication.

The above bear date September 18th.

2383. Jubal Charlton Broadbent, of Rochdale, impts. in safety apparatus for cages and hoists.

2384. Robert Fox, of Limehouse, impd. method of, and apparatus for, securing or fastening metal plates to beams, rafters, and other places, for roofing and other purposes.

2385. John Fletcher, of Betts-street, St. George's-in-the-East, impts. in the machinery or apparatus, and in the processes, for the treatment and manufacture of sugar.

2386. George Smith and Charles Ritchie, of Upper Thames-street, impts. in brooms or brushes for sweeping and dusting.

2387. Edwin Clark, of Great George-street, Westminster, impts. in floating dry docks.

2388. Richard Archibald Brooman, of Fleet-street, impts. in engraving on metal,—a communication.

2389. Henry Lloyd, of Liverpool, impts. in sun-shades or canopies for perambulators and other wheel carriages.

2390. Isaac Shimwell Mc'Dougall, of Manchester, impts. in the manufacture of insoluble oils and greases.

2391. Edward Alfred Cowper and Charles William Siemens, of Great George-street, impts. in apparatus for separating dust from the gases evolved from blast furnaces for smelting iron.

2392. James Gillespie, of Garnkirk, Lanark, N.B., impts. in the manufacture of bricks, blocks, flue covers, and tiles, and in the machinery and apparatus employed therefor.

The above bear date September 19th.

2393. Leon Villette, of Liverpool, impts. in machinery for cutting and shaping cork, with apparatus for registering the manufacture.

2396. Hector Auguste Dufrené, of Paris, impts. in screw wrenches,—a communication.

2397. Daniel Joseph Fleetwood, of Birmingham, impts. in the manufacture of spoons, forks, and other similar articles, and in apparatus or machinery to be employed therein.

2398. William Porter, of Manor-park Lee, Kent, impts. in machinery used in the manufacture of bricks and tiles

2399. John Tye, of Lincoln, impts. in mills for crushing and grinding wheat and other grain.

2400. Ernest Petito, of Grange-terrace, Brompton, impts. in the means of communicating between the occupants of vehicles and the drivers or other attendants thereof.

2401. Daniel Spink, of Weston-super-Mare, impts. in founding or casting metals, and in moulds used for the same.

The above bear date September 20th.

2402. Newman Burfoot Thoyts, of Reading, impd. billiard marker.

2403. John Bostock Hulme, of Manchester, impts. in machinery for excavating earth.

2405. William Watkin, of St. George's-road, Southwark, impts. in, and applicable to, furnaces for the consumption of smoke.

2406. John Goulding, of Worcester, Massachusetts, U.S.A., impts. in bobbin holders.

2407. Edwin William Collier, of the Bishopsgate Railway Station, impd. mode of, and apparatus for, securing the labels of trucks and invoices of goods conveyed on railways.

2408. Alfred Vincent Newton, of Chancery-lane, impts. in railways, and in the wheels for railways,—a communication.

2409. William Clark, of Chancery-lane, impts. in the manufacture of materials for decoloring sugar and other saccharine and liquid matters,—a communication.

2410. Henry Hibling, of Leicester, impts. in the manufacture of boots and shoes.

2411. Benjamin Chaffer, of Burnley, and James Thompson and Charles Thompson, of Padiham, impts. in machinery for grinding, dressing, smoothing, or polishing flags and stones without the use of the ordinary cutting tools.

2413. Richard Archibald Brooman, of Fleet-street, impts. in blast furnaces and in charging the same,—a communication.

2414. William Robert Lake, of Southampton-buildings, impts. in hoisting machines,—a communication.

2415. Alfred Bird, of Birmingham, impts. in purifying water.

The above bear date September 21st.

2416. William Boggett, of Lindsey-row, Chelsea, impts. in manufacturing wire conductors for electro-telegraphic purposes.

2417. Frederick Thomas Brandreth and John Henry Brandreth, of Preston, impts. in machinery for brushing hair.

2420. Henry Rankin, of King William-street, impd. machinery for the manufacture of bags and envelopes made of paper or other fibrous materials, or woven or textile fabrics, either separately or combined.

2422. Joseph Sheldon, of New Haven, U.S.A., impts. in machines for binding grain,—a communication.

2423. Matthew Cartwright, of Tavistock-street, Covent-garden, impts. in the adaptation of elastic material to articles requiring a bellows arrangement, or a partially rigid and partially expandible arrangement.

2424. Alexandre Schultz, of Montmartre, near Paris, impts. in the manufacture of coloring matter, and in the application thereof to dyeing and printing.

2426. James Davidson, of Woolwich impts. in machinery for making casks, barrels, and other wooden vessels of capacity.

2427. Peter Spence, of Newton-heath, Manchester, impts. in the manufacture of white lead.

2428. Charles White, of Bracebridge, Lincolnshire, and Thomas White, of Lincoln, impts. in socks for boots and shoes.

The above bear date September 22nd.

2430. Hon. Jane Elizabeth Tuchet, of Dover, impts. in securing or fastening envelopes.

2431. Edward Thomas Hughes, of Chancery-lane, impts. in sewing machines,—a communication.

2432. William Turner and Samuel Shore, of Tunnicliffe Mill, near Rochdale, and William Halliwell, of Rochdale, impts. in cards used in carding engines, and other similar machinery.

2433. George Davies, of Serle-street, Lincoln's-inn, impts. in the manufacture of horseshoes, and in the machinery used in such manufacture,—a communication.

2434. William John Macquorn Rankine, of Glasgow, impts. in feathering paddles and oars.

2435. John Henry Johnson, of Lincoln's-inn-fields, impts. in generating illuminating gas, and in the machinery or apparatus employed therein,—a communication.

2438. William Edward Newton, of Chancery-lane, impts. in breech-loading fire-arms and in cartridges to be used therewith,—a communication.

2439. Alfred Vincent Newton, of Chancery-lane, impd. apparatus for generating illuminating gas,—a communication.

2440. Gustave Emile Rolland and Emile Léon Rolland, of Paris, impd. liquid composition for cleansing, scouring, and bleaching textile, animal, mineral, and vegetable substances.

2441. Joseph Parkins, of St. John's-wood, impd. apparatus for bordering paper and envelopes.

2442. John Hawkins Simpson, of Kilmuna, Ireland, impd. apparatus or mechanism for locking and unlocking railway carriage doors and for making signals with reference thereto.

2443. Max Schaffner, of Aussig, Bohemia, impts. in treating soda waste to obtain sulphur therefrom.

2444. John Player, of Norton, Stockton-on-Tees, impts. in the manufacture of balls, blooms, or slabs, of malleable iron or steel.

2445. Jacob Dreisorner, of New York, U.S.A., impts. in hydraulic pressure engines.

The above bear date September 23rd.

2446. Richard Williams Barnes, of Manchester, impd. apparatus for. and method of, ascertaining the state of sewers, tunnels, drifts, or other

subterranean works, without descending thereinto, by means of the natural, artificial, or magnesium light, part of which apparatus is applicable to levelling purposes.

2447. William Routledge and Frederick Francis Ommanney, of Salford, impts. in presses worked by steam and hydraulic power.

2449. John Wiggins Coburn, of New Haven, U.S.A., impt. in the manufacture of water-proof soles for boots and shoes.

2450. George Frederic Smeeton, of Halifax, impd. arrangement and combination of the working parts of machinery or apparatus employed for washing, wringing, and mangling clothes and fabrics.

2451. Edward Brooke, jun., of Huddersfield, impd. arrangement of apparatus and materials to be employed for effecting the deodorizing of the noxious gases arising from sewers and drains, and for the more effectual ventilation and inspection of such sewers and drains.

2452. Alexander Prince, of Trafalgar-square, impts. in breech-loading fire-arms,—a communication.

2454. Alfred Vincent Newton, of Chancery-lane, impts. in the construction of presses for hay, cotton, hemp, and other substances,—a communication.

The above bear date September 25th.

2455. Richard Taylor Nelson Howey, of Newcastle-on-Tyne, impts. in tools for securing tubes in tube plates, and for other purposes where concentrated power or adjustment is necessary.

2457. Claude Parigot and Antoine Grivel, jun., of Davies-street, Berkeley-square, impts. in the construction of safes, strong-rooms, and other similar depositories, and in the locks thereof.

2459. John Hargreaves, of Farnworth, near Bolton, certain sanitary impts. in coffins.

2460. William Ambler, of Keighley, impts. in the manufacture of knickerbockers and such like coverings for the legs.

2461. Thomas Frederick Cashin, of Sheffield, and Joseph Felix Allender, of Park-gate, near Sheffield, impts. in the manufacture of iron and steel, and of furnaces and machinery for purifying, puddling, or heating the same.

2462. William Henry Brown, of Sheffield, impts. in bearing and draw-springs, and springs to resist concussion.

2463. Charles Middleton Kernot, of West Cowes, and Nathaniel Symons, of Princes-street, Lambeth, impts. in the construction of railway plant, to ensure the safety of passengers' lives in the event of accident or collision.

2466. William Edward Newton, of Chancery-lane, impts. in fire-arms and ordnance,—a communication.

2467. John Hilliar, of Great Cambridge-street, impts. in apparatus for ventilating and for preventing down draughts in flues.

2468. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in portfolios and paper files,—a communication.

2469. George Tomlinson Bousfield, of Loughborough-park, Brixton, impts. in machinery for tempering and preparing peat for fuel,—a communication.

The above bear date September 26th.

2471. John Taylor, of Chancery-lane, impts. in the construction of washing machines and churns.

2472. George Eveleigh, of Southampton, impts. in the manufacture of paper by the introduction therein of a new vegetable fibrous substance.

2473. Louis Henry Gillett, of Paris, impts. in the construction of vessels for preserving food and liquids.

2474. Alfred Moore, of Moore, near Warrington, impts. in signalling on railways.

2475. James Broun, of Greenock, N.B., impts. in cartridges.

2477. William Morgans, of Brendon Hills, Somersetshire, impts. in coke and charcoal ovens, and in the manufacture of coke, parts of which are applicable to bread, biscuit, and pastry ovens.

2478. Richard Archibald Brooman, of Fleet-street, impts. in washing and wringing machines,—a communication.

2479. John Rodger Arnoldi, of Hunter-street, Middlesex, impts. in steam engines.

2480. John Boffey, of Sheerness, and Charles William Smith, of Buckingham-street, Strand, impts. in compositions used for coating metallic surfaces.

2481. James Jennings McComb, of Liverpool, impd. construction of paddle wheel,—a communication.

The above bear date September 27th.

2483. Rees Reece, of Llandilo, Carmarthenshire, impts. in obtaining and applying sulphurous acid, and in apparatus used therein.

2485. Benjamin Wren, of Stockton-on-Tees, impts. in grinding wheat and other grain, and in apparatus for drying and improving the condition of damp wheat or other grain.

2487. Jean Maublanc, of Paris, impts. in lamps for burning schist, petroleum, and other similar oils, and in the means to be employed in lighting the same.

2489. Arthur Rigg, jun., of Chester, impts. in centrifugal pumps and fans.

2491. Edward Thomas Hughes, of Chancery-lane, impd. self-centering and tightening chucks for drilling machines, lathes, and other machines in which chucks are used,—a communication.

2495. Samuel Dunn, of Old Broad-street, impts. in coffins,—a communication.

2497. Carlo Giuliano, of Frith-street, Soho-square, impts. in the manufacture of chains, bracelets, necklaces, and other analogous articles.

2499. Edward Cottam, of Winsley-street, Oxford-street, impts. in fittings for stables, cowsheds, and piggeries, and in effluvium traps for stables and other places.

The above bear date September 28th.

2501. William Schofield, of Heywood, Lancashire, and John Smith, of Baxenden, Lancashire, impts. in machinery and apparatus for bleaching, soaping, clearing, and washing fibrous and other materials, yarns, and fabrics.

2503. Charles Forster Cotterill, of Cannock, Staffordshire, impts. in connections for, and in stopping, pipes used for conveying water and gas, and for other like purposes, and in preventing leakages in the said pipes, and in apparatus employed therein.

2505. Joseph Duke, of Puriton, near Bridgewater, impts. in the manufacture of cement.

2507. John Addenbrooke, George Addenbrooke, and Philip Anthony Millward, of Darlaston, impts. in collecting or drawing off the gases from blast furnaces.

The above bear date September 29th.

2513. Arthur Hill, of Charfield, Gloucestershire, impts. in candlesticks.

2515. John Henry Johnson, of Lincoln's-inn-fields, impts. in apparatus for lighting and heating, suitable for sick rooms and nurseries, and applicable also as holders for matches, watches, and other necessary articles, —a communication.

2517. William Edward Newton, of Chancery-lane, impd. machinery for feeding fibrous substances to preparing, carding, and other machinery for working wool and other filamentous substances,—a communication.

2519. William Longbottom, of Barnsley, Yorkshire, impts. in weft winding machines, both for winding on bobbins and cops; also for a shuttle to hold the cop when weaving.

The above bear date September 30th.

2523. Charles Denton Abel, of Southampton-buildings, impts. in the mode of treating the roots of the lucerne plant for the purpose of manufacturing paper, pasteboard, fabrics and ropes therefrom,—a communication.

2525. Frederic Jenner, of St. James'-street, impt. in clasps or fastenings.

2527. Silas Covell Salisbury, of New York, impts. in producing and combining gases, to be used for heating purposes, and in the construction of retorts for producing and combining such gases.

The above bear date October 2nd.

2531. Charles Pomeroy Button, of Cheapside, revolving cover for dishes, bowls, and other vessels requiring a moveable cover,—a communication.

2533. Charles Walker and William Preston, of Batley Carr, Yorkshire, impts. in machinery for carding wool or other fibrous substances.

2535. Richard Archibald Brooman, of Fleet-street, impts. in apparatus for decomposing and superheating liquids, vapours, and gases,—a communication.

2539. Joseph Heydon, of Coventry, impts. in bench stops or abutments used for planing wood and other operations.

The above bear date October 3rd.

2543. James Wadsworth, of Heaton Norris, and Thomas Hall and Samuel Bonser, of Stockport, impts. in the taking-up motions of looms for weaving.

2545. Levi Hewitt, of Higham Ferrers, North Hants, impts. in lamps for burning paraffin, and in feeding apparatus for supplying the same.

2547. William Blakey Stocks, of Liversedge, James Whitwam, of Huddersfield, and William Blakey, of Batley Carr Top, near Dewsbury, impts. in means or apparatus for cutting or shearing the nap, or pile of nap, or pile fabrics.

The above bear date October 4th.

2551. Michael Henry, of Fleet-street, impts. in sewing machines,—a communication.

2553. John Millar, of Bethnal-green, and Bethel Burton, of Hackney, impts. in breech-loading fire-arms.

2555. William Robert Barker, of New Bond-street, impts. in apparatus for administering injections and douches to the human body.

2557. Edward Marsland and Peter Williams, of Manchester, impts. in and applicable to machines for opening and cleaning cotton and other fibrous materials.

2559. William Henry Phillips, of Nunhead, impts. in apparatus and means for extinguishing fires, part of such improvements being applicable for other purposes.

2561. Archibald Richard Shaw, of St. Leonards, impts. in brakes for carriages and other vehicles.

The above bear date October 5th.

2567. Richard Archibald Brooman, of Fleet-street, impts. in rotary engines and pumps,—a communication.

2569. George Wightwick Rendel, of Newcastle-upon-Tyne, impts. in the construction of gun carriages.

2571. Victor Jean Baptiste Germaix, of Philippeville, Algiers, impts. in the manufacture of bricks and other analogous materials.

2573. Robert Macintyre Cameron and Duncan Cameron, of Edinburgh, impts. in pens used for writing.

2577. Thomas Machin, of Andover-road, Holloway, impts. in machinery or apparatus for the manufacture of wooden spills.

The above bear date October 6th.

2581. Henry Griffith Craig, of Passage West, Cork, impts. in the construction of railway carriages, waggons, and trucks, and other road vehicles.

2587. John Howard, of Fenchurch-street, impts. in the construction of compound cylinder engines,—a communication.

2593. Julius Homan, of The Grove, Camberwell, impts. in the construction of wrought-iron girders.

The above bear date October 7th.

2597. Robert Walmsley, of Liverpool, impts. in apparatus for mangling and calendering.

2599. Thomas Miles, of Queen-street, Finsbury, impts. in the manufacture of scent and smelling bottles.

2601. William Clark, of Chancery-lane, impts. in apparatus for propelling vessels,—a communication.

The above bear date October 9th.

2607. George Glover Rich, of Stanley-road, Hackney, impts. in the action of upright pianofortes.

2609. John Garrison Woodward, of St. John, New Brunswick, impd. ventilating apparatus for use in steam boats, vessels, and other places requiring to be ventilated.

The above bear date October 10th.

New Patents Sealed.

1865.

563. David Chalmers.
616. Thomas Turton.
722. N. N. Solly.
785. C. Farmer and T. Turner.
787. William Arthur.
788. R. A. Brooman.
789. William Clark.
791. J. Smith and S. A. Chease.
793. B. J. Webber.
799. W. J. Coleman.
800. A. P. Tronchon.
804. Alfred Paraf.
805. James Wright.
808. G. E. Donisthorpe.
809. W. M. Baker.
815. Duncan Mackenzie.
816. L. A. Leius.
818. A. B. Von Rathen.
821. J. Lees and M. Mellor.
823. T. Roberts and L. Luc.
826. J. C. Morgan.
827. M. P. W. Boulton.
828. W. Simons and A. Brown.
833. Robert Lublinski.
835. Joseph Green.
838. Daniel Arnold.
841. G. F. Marchisio.
843 Edwin Wolverson.
844. HC. Hurry.
850. John Dodd.
851. William Richardson.
853. William Betts.
860. Joshua Rooke.
863. J. Bruckshaw & W. S. Underhill.
864. Ferdiand Le Roy.
866. J. C. Thompson & J. J. M. Green.
869. John Morris, jun.
870. J. Millar and J. Laing.
871. J. C. C. Halkett.
874. A. D. Gascon.
875. Frederick Thomas.
876. F. A. Mocquard.
877. R. Young and C. F. O. Glassford.
878. F. W. Webb.
880. Elliott Savage.
881. J. L. Pulvermacher.
882. Joseph Wright.
883. W. N. Wilson.
884. William Irlam.
885. William Brookes.
886. R. C. Robinson.
887. E. Leigh and F. A. Leigh.
888. F. A. Leigh.
889. Richard Holroyd.
891. John Player.
894. T. W. Nordenfelt.
896. W. M. Neilson.
898. William Savory.
899. William Brookes.
900. A. A. Croll.
904. Thomas Cook.
906. J., D., B., and O. Swarbrick.
907. Lang Bridge.
908. J. Poole and F. Brown.
910. H. A. Bonneville.
922. Henry Lewis.
923. R. A. Brooman.
924. George Burt.
926. James Kennan.
928. A. W. Pearce.
940. Frederick Brown.
945. J. R. Wigham.
948. Alfred and Henry Illingworth.
949. William Brookes.
950. Charles Martin.
951. Robert Baynes.
954. W. Moody and W. J. Huband.
956. William Bulstrode.
962. J. G. N. Alleyne.
963. Henry Simon.
966. W. Teall, L. Lepaige, and E. T. Simpson.
967. J. I. Darribet.
969. C. W. Lancaster.
970. Edward Ritherdon.
971. F. R. Ensor.
972. Charles Esplin.
976. E. H. Newby.
985. Richard Garrett, jun.
986. Pierre Hugon.
987. Andrew Muir.
989. Edward Welch.
990. James Thompson.
991. S. Smith and J. W. Jackson.
994. James Brown.
995. Henry Edmonds.
1000. Thomas Skidmore.
1002. W. E. Gedge.
1005. William Weatherley.
1007. George Davies.
1009. Victor Albert Prout.
1011. A. G. Hunter.
1012. Siegmund Moore.
1013. Thomas Turton.
1018. R. A. Brooman.
1020. William Brooks.
1023. Charles Vaughan.
1025. William Clark.
1026. David Payne.
1029. J. H. Johnson.
1030. J. H. Johnson.
1032. Archibald Turner.
1038. John Haworth.
1039. Henry Beilson.
1040. C. Boschen, J. Bindner, and W. Caffon.
1041. F. P. Warren.
1042. H. Sykes and G. Jarmaine.
1043. John Walker.
1044. G. A. Montenat.
1045. J. M. Hart.

1046. T. J. Mayall.
1047. F. Bapty and E. B. Sayers.
1049. J. S. Bickford.
1055. Albert Westhead.
1061. C. Turner and T. Rooms.
1062. R. A. Brooman.
1063. Thomas Bennett.
1065. John McDowall.
1066. J. M. Courtauld.
1068. William Clark.
1070. Mark Smith.
1071. Alexander Henry.
1072. F. Newbigging and A. Hindle.
1074. Louis de St. Céran.
1075. E. Morgan and G. H. Morgan.
1076. Joseph Dougan.
1077. A. W. Hale.
1079. F. C. Bakewell.
1081. J. J. Jenkins.
1083. William Bedder.
1084. T. Whitehead and N. Nassey.
1085. J. Gardner, R. Lee, G. H. Wain, S. Hargrove, C. Hargrove, and S. Hargrove, jun.
1086. J. E. H. Andrew.
1087. R. A. Brooman.
1088. R. A. Jones and Joseph Hedges.
1093. Maurice Vogl.
1096. H. K. Taylor.
1099. Meguerditch Houssepain.
1100. T. Hampton and J. Abbott.
1102. F. A. Abel.
1103. William Hale.
1105. William Beaven.
1106. William Robinson.
1108. J. Y. Betts.
1109. Francis Wise.
1110. T. Greaves and J. S. Wright.
1111. D. S. Buchanan.
1113. Edward Wilson.
1115. A. C. Herrmann.
1120. H. E. Newton.
1122. Richard Canham.
1123. Collinson Hall.
1124. O. C. Evans.
1125. Edward Lord.
1127. J. H. Wilson.
1129. C. J. Keenan and J. A. Keenan.
1130. A. Grainger and C. M. Girdler.
1137. H. A. Bonneville.
1141. W. E. Gedge.
1143. J. J. Parkes.
1144. William Clark.
1147. W. E. Newton.
1150. Thomas Walker.
1151. George Davis.
1153. J. N. Brown and T. D. Clare.
1154. J. N. Brown and T. D. Clare.
1155. John Wilkinson, jun.
1157. William Elder.
1158. J. T. Bucknill.
1160. William Oxley.
1161. William Clark.
1175. J. W. Lowther.
1177. James Carr.
1187. T. C. March.
1189. A. C. Henderson.
1204. Francis Gregory.
1209. George Johnson.
1223. J. H. Johnson.
1225. T. H. Campbell.
1228. W. E. Newton.
1264. W. E. Newton.
1272. J. H. Johnson.
1286. J. H. Johnson.
1301. W. J. Rice.
1360. J. Worrall and T. Hughes.
1372. J. Molden, J. Newsome, and J. Akeroyd.
1375. R. T. Birt.
1378. William Eassie.
1387. A. V. Newton.
1445. William Clark.
1474. C. H. Murray.
1513. W. E. Newton.
1541. W. E. Newton.
1554. A. C. Henderson.
1561. W. E. Newton.
1626. H. A. Bonneville.
1641. George Haseltine.
1650. George Clark.
1679. James Gale.
1735. W. E. Newton.
1748. W. R. Lake.
1752. John Calvert.
1756. J. F. Jones.
1762. Stephen Wright.
1776. J. Jobson and J. F. Dickson.
1782. George Carter.
1785. C. F. Claus.
1787. J. F. Jones.
1834. Nathaniel Jenkins.
1838. T. C. McKeen.
1843. J. Saunders and J. Piper.
1846. H. A. Bonneville.
1868. J. P. Wint.
1881. H. E. Gilles.
1897. M. L. Parry.
1909. W. S. Yates and A. Freeman.
1923. M. B. Schumann.
1941. A. V. Newton.
1944. William Barton.
1958. W. E. Newton.
1959. R. B. Mitchell.
2049. A. V. Newton.
2203. H. A. Bonneville.
2204. H. A. Bonneville.
2205. H. A. Bonneville.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

NEWTON'S
London Journal of Arts and Sciences.

No. CXXXII. (NEW SERIES), December 1st, 1865.

THE GAS EXPLOSION AT NINE ELMS: ITS CAUSE AND THE MEANS OF PREVENTING SUCH EXPLOSIONS.

Amongst the worn-out relics bequeathed to us by our Saxon ancestors, what is called a coroner's inquest may very properly be placed with the bows and arrows, the shields, the bill-hooks, and other curiosities now rendered altogether useless by the progress of civilization. And if any evidence is required in support of this opinion, it may be found in the particulars of the "*crowner's quest*" lately concluded upon the sufferers of the explosion at the works of the London Gas Company, near Vauxhall-bridge. To conceive of a jury of twelve ordinary men being suddenly inspired with the technical and scientific knowledge required for the investigation of such a problem as the Nine Elms' catastrophe, is about as rational as to suppose the same men capable of elucidating the mysteries of an arrow-headed inscription from Nineveh, or determining the cause of death of an Egyptian mummy from the Great Pyramid. The mere idea of the thing gives rise at once to a sensation of contempt, bordering upon the ridiculous; and a moment's thought serves to convince us, that except to the coroner himself, and the few paid witnesses, the "quest" is a hollow farce—an "unreal mockery," that only hides the skeleton, and diverts public attention from the real evil. There is an old axiom which says, "That which is worth doing at all, is worth doing well," and assuredly, if the object of those who influenced the decision of the Nine Elms' jurymen was to mislead the public mind into a belief that such a catastrophe could not occur again, we must give them credit for having done their work "well." The argumentative anodyne was dexterously administered, as we may see, by the manner of its subdivision: first, all the mischief had been caused by the men who were dead, and who could not therefore deny the accusation of having tilted the governor and put their feet on it; secondly, these men were quite ignorant of gas matters, and had been only casually employed at this kind of work; thirdly, such an explosion had not, and could not, and would not have occurred in the hands of the

regular workmen of the establishment—or, in other words, the thing was a barely possible casualty resulting from the most crass ignorance. In support of this tranquillizing mixture, it was deemed necessary to show that neither gas-holder No. 1 nor gas-holder No. 2 had exploded; but it would have been much better if this part of the evidence had been omitted, for although dead men cannot speak, yet sheet-iron can tell a tale. To render our comments upon this matter not only intelligible, but unexceptionably equitable, we will quote the words of the evidence as set down in the *Weekly Times* newspaper of the 12th of November, from which we learn that "Dr. H. Letheby, of 17, Sussex-place, Regent's-park, Medical Officer of Health for the City of London, and Professor of Chemistry at the London Hospital, had paid two visits to the scene of the recent accident, for the purpose of examining the effects of the explosion, and the cause thereof. His attention was first directed to the state of gas-holder No. 1, where the greatest mischief was done." Amongst other damages to this gas-holder, he noticed that, "on this (the north) side, the crown of the gas-holder was perfectly sound, and did not indicate the action of any internal explosive force upon it, but at the opposite or southern side next the meter-house, the iron plates which formed the crown of the holder were torn through, and folded over, as if from the action of a very *local* internal force, and there rested upon them a large mass of lead, the *débris* of the meter-house, which must have fallen there *after* the plates had been rent and turned over." Before proceeding any farther with our quotation, we will ask our readers to notice the words "action of a very *local* internal force." A gas-holder is filled with an extremely elastic fluid, and therefore the idea of the accumulation of local internal force in such a holder is either a complete absurdity, or it indicates the separate existence in the holder of two different gaseous compounds, one of which is explosive, the other non-explosive; and consequently this "very local internal force" must have arisen from the combustion of the explosive part of the contents of No. 1, by which "the southern side of the crown of the holder was torn and folded over:" and mark! after this was done, "the lead, or *débris*, of the meter-house fell upon it."

Probably, if Dr. Letheby were shown a burst bladder, he would discover, at the place of rupture, some "very local internal force;" but we ask, What made this local internal force in the case of gas-holder No. 1, and what limited its action? That it was from *within* to *without* is clear, by the folding over of the iron plates; for had the force been from without to within, the plates might indeed have been folded in the inside of the holder, but could never have been torn out and folded on the outside. Moreover, it does not appear to be a very easy thing to tear and fold up these iron plates, for, according to Dr. Letheby, a

"large mass of lead, the *débris* of the meter-house," had fallen upon these very plates, but had not gone through them, although, being a large mass, it must have come with no small *local* external force, if it were blown from the meter-house. And to make confusion worse confounded, in spite of this impetuous transit, this mass arrives at gasholder No. 1, only after all the damage has been done, although the distance is but 22 feet! The *local* internal force in holder No. 1 must, then, have been pretty active, it would seem, in its operations; and it is not a little fortunate, perhaps, that these operations were so localised. A story is told of a militia recruit who had a great fear of fire-arms, and, being out at exercise, charged his musket nine times, but every time cunningly evaded discharging it, until at last he was detected by the commanding officer, who ordered him out to the front of the party, there to fire off his musket. Thus compelled, he drew the fatal trigger, and was immediately knocked down by the recoil. One of his comrades then ran to help him, and to pick up the musket—"Let her alone! let her alone!" cried the prostrate hero; "there's other eight in her as bad as that." Perhaps gas-holder No. 1, like the recruit's musket, has several other specimens of "local internal force" yet left in her, in addition to the one discovered by Dr. Letheby; but, for the investigation of this important point, we must resume our quotations. Influenced, no doubt, by a kind of hazy notion that this "local internal force" in No. 1 might, after all, be first cousin to an explosion, the Coroner put a question which elicited from Dr. Letheby the following answer—"Had there been an explosion in either of the gas-holders, not a vestige of the place would have been left."

Now we will not dwell upon the manifest tendency of this reply to lead the jury to a *satisfactory* verdict, but we are content to ask our readers to pay particular attention to the following scientific facts:—Coal gas, when mixed with atmospheric air in certain proportions, forms an explosive mixture, and the force or violence of the explosion caused by the ignition of this mixture depends altogether upon the relative proportion of the ingredients,—just as in gunpowder, where certain proportions of charcoal, sulphur, and saltpetre form an explosive compound, although certain other proportions of the same things form a compound which will not explode at all. If sixteen parts of air be mixed with one of coal gas, the mixture will explode feebly, and with little force; but if the proportions be gradually altered from sixteen parts of air and one of coal gas down to ten parts of air and one of coal gas, the violence or explosive power of the mixture will be seen to increase gradually, until this latter mixture is reached, when the explosive power attains its maximum. If, now, we still go on diminishing the proportion of atmospheric air, we shall perceive that

the explosive power of the mixture also diminishes, until we reach a point at which two parts only of air are mixed with one of coal gas, when the power of explosion in the mixture ceases altogether, or becomes nil. Briefly, then, seventeen parts of atmospheric air and one of coal gas will neither explode nor burn; ten parts of air and one of gas will explode violently; and two parts of air and one of gas will burn, but will not explode; and within the range of these limits mixtures may be formed having any required degree of explosive force, from a feeble expansive push to a rapid and violent deflagration. When Dr. Letheby, therefore, as a chemist, answered the question of the Coroner as he did, he must or should have known that he was leading the jury astray, for his answer applies only to the condition in which the gas-holder is supposed to be filled with a mixture consisting of ten parts of air and but one of coal gas—a most preposterous and unlikely assumption, in regard to the inquiry before the jury. Had he explained this matter to the jury, and told them, moreover, that a mixture of three parts of air and one of coal gas would produce exactly such a "powerful pushing force" as, in his own words, appears to have been applied to the gas-holder, then he might be said to have answered the question of the Coroner in a manner calculated to aid the purpose of the inquiry: as it is, his answer needs no comment, unless we were to say that it has "*over-tilted* the governor," and "put his foot in it," which naturally brings us to the evidence of "Richard Harvey, a foreman stoker in the service of the London Gas Company."

We wish to deal gently with the evidence of this poor man, and to make every allowance for his position and prejudices. He has a theory, and he supposes that "some one must have put his foot upon the governor; that one or more of the men must have trod upon it and tilted it on one side, after which they held it down on the opposite side to rectify it," by which a great escape of gas was caused; and, hence, an explosion of so terrific a nature as to blow out all the windows and doors in the neighbourhood for a quarter of a mile all round, according to the account in the *Weekly Times* of November 5th, which, under the heading "Effects at a Distance," says: "An inspection of the various streets within a quarter of a mile of the spot where the explosion took place has disclosed facts which otherwise would hardly have been credited; for not only have windows been broken in thousands, but at considerable distances persons were knocked over and in some instances received rather serious injuries."

To produce such effects, a very large and rapid evolution or escape of gas must have been indispensable; but human beings can no more live in coal gas than they can under the surface of the Thames. If, then, so rapid and large an escape of gas took place as is requisite to

account for this violent explosion, and if this escape occurred in the room occupied by these five or six men, and almost under their very mouths, whilst holding down the governor, nothing in the world could prevent them from being asphyxiated or, at least, rendered insensible by the action of the gas. They could not have held down the side of the governor under such circumstances, from the simple fact that they could not have held themselves up. The quantity of gas required for the explosion would be more than sufficient to suffocate these men in the position they are described as occupying—that is, "holding down the governor on the side next the wall," the doorway being blocked up by several men, through whom Harvey had to "push his way" to get into the room. Indeed, the more we examine this theory of Harvey, the less likely it becomes; and when we recall to mind the number of cases in which gas explosions have occurred in apartments quite as large or larger than this meter-room, without blowing the whole neighbourhood down for a quarter of a mile all round, the meter-room and governor hypothesis falls to the ground as quite untenable: so that, in spite of all the argument concocted to the contrary, No. 1 gas-holder has evidently had something to do with the explosion. Dr. Letheby, indeed, according to the report in the *Telegraph* of November 10th, is quite satisfied that the iron plates on the side of the gas-holder No. 1 were driven in by something which he calls "explosive force that radiated in all directions from the meter-house," and after driving in the side plates went inside the gas-holder and drove off and coiled up the iron plates on the roof of the holder, and all this before the lead *débris* from the meter-house had arrived. Now, the only thing through or by means of which this "radiating force" could act must have been the air of the atmosphere; and if the "force" began or centered in the meter-house, it must have been infinitely greater in the meter-house than at the gas-holder No. 1, since this holder is twenty-two feet from the meter-house. But if the "radiating force" could tear off iron plates at a distance of twenty-two feet, how comes it that *anything at all* was left of the poor fellow Harvey, who, although in the very room itself at the time of the explosion, was not killed, but, in reply to a question from Mr. Besley, says, "the flash ignited the gas which was escaping from the governor, and the explosion followed. I was thrown down, but retained *my senses!!* I heard the noise of the explosion following the flash. I did not hear more than one explosion"? And yet this man is alive after having suffered from the concentrated effects of a "radiating force," which at a distance of twenty-two feet "pushed," so says Dr. Letheby, "the holder No. 1 with so much force against the columns on the northernmost side, that it broke the rollers, drove them several inches into the plates of the holder, tore up those on the

southern side of the crown, and broke through the plates on the side," so as to admit the entrance into the holder of a "very local internal force;" and not content with this, the "radiating force" had produced a rent in the side and top of No. 2 holder at a distance of 320 feet! And yet, we repeat it, this man Richard Harvey, who was in the meter-house all this time, is still alive and able to give evidence at the inquest!! We remember to have seen a painted portrait of Jupiter hurling his thunderbolts in all directions, but surely Harvey could now sit for a carte-de-visite photograph in that character. Such a man, indeed, might consistently live in a bomb-shell, or smoke his pipe in a loaded cannon.

Quitting, however, the details of this miserable coroner's farce, let us see whether there is not something to be said upon the subject of the explosion that may be useful both to the public in general and to gas manufacturers in particular. True indeed it is, that great difficulties stand in the way of any one who seeks to render a purely technical question interesting to the general reader. "*Brevis esse laboro, obscurus fio,*" to write briefly is to write obscurely: to be thoroughly explanatory is to be painfully prolix. The prospect is not encouraging, but we will take our chance.

About twenty-five or thirty years ago, coal gas was manufactured exclusively in retorts made of cast-iron, and at that time the process was extremely simple and safe. The coal was thrown into a red hot retort, the mouth of which was then closed, and the gas thus formed was made to pass through a perpendicular tube, the end of which dipped under the surface of a quantity of water kept in a horizontal pipe, or, as it was called, a "hydraulic main," from whence the gas passed on to reach ultimately the gas-holder. The purpose of this water in the hydraulic main was to prevent the return of the gas down the perpendicular tube when the mouth of the retort was uncovered from any cause. This dipping under the surface of the water necessarily formed a slight obstruction to the passage of the gas into the hydraulic main, so that if a crack or hole occurred in the retort, the gas, finding less obstruction in that direction, went out at the hole into the furnace and was burnt or lost; but such cracks or holes were by no means very common with the cast-iron retorts, so that this evil was not much felt. In process of time it was discovered that gas retorts could be made more cheaply of clay than of iron, and that the clay retorts, in addition to cheapness, possessed some other advantages. There was, however, one drawback, they were more liable to crack by the action of the fire than the cast-iron retorts; and, therefore, they were more liable to "leak" and waste the gas. To remedy this inconvenience, the water pressure upon the end of the perpendicular or

"upright" tube in the hydraulic main had to be removed, or, rather, it had to be neutralised in such a way as to retain all the pressure that prevented the regurgitation of the gas down the "upright," whilst it allowed the gas to freely flow on in the opposite direction—that is to say, into the hydraulic main. This was done by placing a kind of pneumatic pump or "exhauster" in such a situation that it sucked the gas, as it were, out of the retort, and completely prevented all loss through the cracks in the clay retort. Thus far, theoretically, all seemed to go well, but in practice a difficulty arose: the quantity of gas given off at different periods of a charge of coal in a retort is extremely variable: how, then, was the effect of the "exhauster" to be accommodated to this, so as not to over-exhaust the hydraulic main, and not only draw in air through the cracks in the retort, but, worse still, draw in air through the upright pipes of those retorts which, not being in action, had their mouths uncovered? This dilemma led to the construction of a kind of "regulator" which, undoubtedly, in the hands of a careful superintendent, may be trusted with this delicate and very dangerous duty. When, however, we come to consider the terribly uncertain and intangible nature of coal gas, few will hesitate to declare that the more simple the apparatus, and the less we have to trust to the skill and care of men, the better. If by any want of care or want of skill, or want of anything, this exhauster, with its regulator, can so overdo its duty as to suck atmospheric air into the pipes and ultimately mix the air with the coal gas in the gas-holder, then this exhauster is an instrument too dangerous for use in any gas works situated in a populous neighbourhood. And we deliberately assert that this over-duty of an exhauster can take place—that, in fact, an exhauster is an instrument too dangerous to be entrusted to the care of common workmen, such as are frequently left for hours together in full charge of our gas works. With this, then, the question arises—Is there an exhauster in use at the Nine Elms Gas Works, and if so, had it not overdone its duty on the 31st of last October? Upon this subject there has been a very remarkable silence: the word "exhauster" never once occurs in the evidence given before the coroner's jury. Dr. Letheby, who examined everything, and who made "two visits to the scene of the recent accident," has nothing to say upon this important point. Yet it is clear that this matter should have been most carefully inquired into: were there no leaks *into* the pipes? Was the hydraulic main thoroughly level, so that *all* the dip-pipes were equally covered with water? But what is the use of asking such questions now? The only thing left is to examine whether the meagre details of the accident, such as they have been given to the coroner's jury, do not accord better with a supposition of over-action in the exhauster than with any other cause of mischief whatever.

We have already shown the untenable nature of the supposition that the centre of so terrific an explosion could have been in the very room from whence a living man was subsequently taken. Similarly we have pointed out, in regard to the tilting theory, the certainty of suffocation to the five or six men said to have tilted the governor; in fact, this suffocation must have occurred according to the calculations of Dr. Letheby and the declarations of John Marvin, assistant manager of the gas works. Dr. Letheby tells us that the contents of the meter-house was "61,000 cubic feet," and Marvin declares that he was in this house, and "saw the governor in action, only ten minutes before the explosion, and it was then in perfect order." Dr. Letheby calculates that one-eighth of the aërial contents of the meter-house must have been coal gas; therefore, assuming no gas to have escaped out of the door or window, and that it began to escape from the governor the very moment Marvin turned his back, we have here an escape of 7625 cubic feet of coal gas in ten minutes, or more than 760 cubic feet per minute—and this, too, almost immediately under the very mouths of these five or six men! We do not think it necessary to dwell any longer upon so gross an absurdity, more especially as we are about to appeal to the patience of our readers, whilst we narrate a few chemical facts.

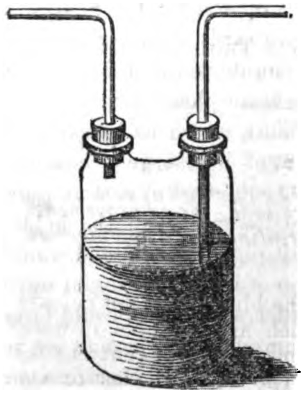
Gases, like liquids, do not mingle together very readily by mere contact; they require time or some moving power to mingle them, so that a gas heavier than atmospheric air may be poured from one vessel into another like water, or, if it be lighter than air, it may be transferred from one inverted vessel into another, without admixture with the air. This fact is very ingeniously described in the *Traité de Chimie Generale* of those eminent French chemists, Messrs. Pelouze and Fremy. Speaking of the lightness of hydrogen gas, these gentlemen say: "Si l'on met l'éprouvette contenant l'hydrogène en communication par son orifice, avec une autre éprouvette remplie d'air atmosphérique, en reversant les deux éprouvettes de telle sorte que celle qui contient l'air se trouve en haut, et celle qui contient l'hydrogène en bas, on reconnait que l'hydrogène a pris la place de l'air atmosphérique, et l'air celle de l'hydrogène." And the same repugnance to admix is shown in the account of the Grotto del' Cane in Italy. The floor of this cavern is covered, to the depth of about eighteen inches, with a stratum of carbonic acid gas, which does not mix with the air above it, so that a man may enter the cavern with safety; but if a small animal like a dog enters, it is immediately asphyxiated, because its mouth is below the surface of the carbonic acid gas. After this brief elucidation, we trust that our readers will understand that it is possible to fill the upper three-fourths or any other portion of a gas-holder with coal gas, and

afterwards to fill the lower portion with atmospheric air; and this, too, without causing a complete intermixture of the gas and the air. In fact, in a large gas-holder, the contents of which are necessarily tranquil, it would probably require hours to effect a thorough admixture of the substances we have mentioned, because there would be scarcely any other agent than the diffusive power of gases to cause the combination. Thus, then, gas-holder No. 1 may, on October 31st, have been more or less charged with coal gas in its upper part, and afterwards, by the undue action of the exhauster or something else, the lower part may have been filled with a stratum of atmospheric air, or an admixture of air and coal gas, having a much greater specific gravity than the coal gas at the top. In this case, the first noticeable effect would be to cause the governor upon the outlet pipe to blow, and for this reason. Coal gas is lighter than air, in the proportion of about three to five; or, speaking in general terms, one cubic foot of coal gas is half an ounce lighter than the same bulk of atmospheric air; so that the buoyancy or ascending power of every cubic foot of coal gas contained in a balloon, or gas-holder, is equal to half an ounce: consequently 75,000 cubic feet of coal gas will generate an ascending force of about one ton. But it is evident that, if this gas be substituted by common air, the force will cease, and then the gas-holder will press downwards with a weight of one ton, for it must be explained that the counterpoise weights of a gas-holder are adapted to coal gas and not to atmospheric air.

Now, suppose No. 1 gas-holder at Nine Elms, which had a capacity of 1,000,000 cubic feet, to have received part of its charge of coal gas, and then to have received accidentally 75,000 cubic feet of common air, this air, as we have seen, would rest at the lower part of the holder from whence it would flow freely into the exit-pipe or main, and would cause an additional pressure from the one ton of increased weight upon the governor attached to that main. And such a pressure would force the gas beneath the lower edge of the drum of the governor, or, in technical language, cause the governor to "blow." If, therefore, we next presume this air to have become mixed with one-tenth of its bulk of coal gas, we have an explosive mixture filling the main from the meter-house to the holder, and occupying the lower part of the holder to a depth of a few inches. How such a mixture could take fire it is not difficult to guess, looking at the numerous lights burning in connection with it; but it is very remarkable how closely the theoretical effects of an explosion in this case agree with those actually recorded in the evidence before the coroner's jury. That the governor did blow is well established, and if the explosive mixture in question did ignite, it would convert the main passing from the meter-house to No. 1 holder into a prodigious cannon, the discharge from which would take

place at both ends simultaneously. At the meter-house end it would produce such effects as are recorded, and in the gas-holder it would shoot up and blow off a part of the roof, just as appears to have occurred. It would also ignite the rest of the explosive mixture in the holder; and now all we want to know is—Was the hole in the roof of the holder directly above the exit-pipe leading to the meter-house, or was it in the line of the axis of that pipe? The hole, we are told, was on the southern side of the roof: was the exit-pipe also on that side? for, if so, the holder would, as a matter of course, be driven towards the opposite or northern side, in consequence of the explosion in the holder having commenced on the southern side of the centre of the tank. But to these questions we find no answer in the evidence.

The grand point remaining for consideration is—Can a means be devised by which, in the event of atmospheric air being drawn into the pipes by the exhauster or any other cause, the presence of this air can be easily and infallibly detected? We say, Yes, it can, and by the following simple method:—Take a two-necked pint bottle, and fit the necks with corks, to receive each a small glass tube in the way shown by the accompanying figure. Into this bottle put, first, half an ounce



of anhydrous sulphate of manganese previously dissolved in one ounce of warm water, then add two ounces of tartarised soda also previously dissolved in three ounces of warm water; when these are well mixed together, pour in half a pint of a caustic solution of potash, and agitate the whole so as to form a clear solution. After this, fix in the corks as rapidly as possible, in order to exclude the air, and push one of the glass tubes down just below the surface of the liquid, leaving the other with its open end inside the bottle near the cork, as shown. This apparatus, which may be called the "detector," is now ready, and all that is required is to cause a constant stream of the gas, at the rate of about one cubic foot per hour, to pass through the fluid in the bottle by means of the two glass tubes. At the beginning, the fluid is clear and almost as colourless as water, and with pure gas will so remain; but if it be exposed to the air, or if the coal gas passing through it be mixed with air or with oxygen, the fluid speedily becomes of a dark brown hue, and ultimately assumes the appearance of strong porter or writing ink. This change arises from the fact that the colourless protoxide of manganese is changed into the black hydrated sesquioxide, by the agency of the oxygen in the air.

To render the detector quite accessible to all parties interested in coal gas, we have chosen the above ingredients, because they may be easily had in almost any respectable druggist's shop. Tartarized soda is commonly known by the name of Rochelle salt, and the solution of potash is the fluid known as liquor potassæ, and employed by medical men. The public at large may, therefore, detect the existence of common air if present in the coal gas supplied to them, and it is scarcely possible to suppose that gas manufacturers will neglect to use so simple and inexpensive an indication of danger.

In conclusion, we will venture to offer a few words of advice to gas directors in general. We say, Seek not to appease the hungry shopkeeper's cry for "cheap gas"—seek, rather, to improve and enlarge the intellectual status of your workmen. See that they all understand the details of the various processes carried on in the manufacture of coal gas, and, moreover, that they are all acquainted with the nature and properties of the dangerous substance thus produced. When you have done this, you will in effect have established a very satisfactory insurance upon your otherwise non-insurable property; for your gas works will then be upheld by the insurance offices of human knowledge, human gratitude, and the sense of self-preservation.

LEWIS THOMPSON, M.R.C.S.

Recent Patents.

To EDWARD THOMAS HUGHES, *of Chancery-lane, for improvements in treating aniline colours for dyeing and printing—a communication.*—[Dated 6th December, 1864.]

THE inventor takes one part by weight of the blue and violet colours of commerce (obtained from magenta, and which are insoluble in water), in the wet or dry state, and dissolves them in from twenty to forty parts of the strongest boiling alcohol. The light shades of violet require the least alcohol, and the blue and dark shades of violet require the most. The quantity of alcohol used varies also in proportion as the solution is effected under pressure or not.

The vessels used for dissolving may be of any suitable form, but to prevent loss of alcohol, closed metallic vessels are preferred, and for the same reason closed metallic vessels for the subsequent precipitation are used, supplied with suitable agitators. In the vessel used for precipitation about two hundred to four hundred parts of cold water are put, or about two hundred to four hundred parts of a cold solution of common salt, containing about one part of salt to five parts of water, or about two hundred to four hundred parts of cold water containing three parts of caustic potash, soda, or ammonia, or their carbonates, or the same quantity of a mixture of any proportion of the before-mentioned saline or alkaline solutions.

During brisk and constant agitation of the precipitating liquid the alcoholic solution of the colouring matter is allowed to fall into it either in single drops or a very fine stream, and by these means the previously dissolved colouring matter is precipitated in this fine state of subdivision. The insoluble colour is now separated from the filtrate by any of the well-known kinds of filters, or by a centrifugal drainer. The precipitate, after washing, may be ready for use. The filtrate is now submitted to any of the known means of distillation, for the purpose of recovering the contained alcohol in a concentrated form, which recovered alcohol may be used for dissolving further quantities of the colours. The clear solution thus obtained is then allowed to drop under the same conditions as those described for the first process, into twenty times its quantity of cold water, containing hydrochloric acid of 22° Baumé, equal to one and a quarter times the weight of the aniline used. The so-obtained precipitate is then separated from the filtrate by the means specified in the first process, and after being well washed is fit for use. The filtrate is then subjected to any of the known processes for the purpose of recovering the aniline. This fine subdivision of the colours can also be effected by dissolving them in concentrated sulphuric acid in the following manner:—Take one part by weight of the afore-mentioned colour, and dissolve it in twenty to thirty parts of concentrated sulphuric acid of about 66° Baumé, either cold or at a temperature not exceeding fifty centigrade, so as to avoid the formation of that blue known as Nicholson's soluble blue. Then drop the clear solution thus obtained into ten times its weight of cold water, or water containing sufficient alkali to neutralise the sulphuric acid, used under the same precautions as those specified above. The finely-divided precipitate is separated from the clear liquid either by filters or a centrifugal drainer, and after washing is ready for use.

The patentee claims, "the rendering of the blue and violet colours of commerce obtained from magenta, and which are insoluble in water, in a fine state of subdivision, so that without further use of alcohol or other solvent they are in a fit condition for use in dyeing and printing, by first dissolving them in alcohol or aniline, and subsequently allowing the solutions so obtained, under brisk and constant agitation, to drop into cold water alone, or into cold water containing in solution neutral salts, caustic or carbonated alkali, or (as in the last-described process, when aniline is used) into cold water containing hydrochloric acid, and subsequently recovering the solvent employed, as described in the last process."

To CHARLES HANCOCK, *of West-street, Smithfield, and* STEPHEN WILLIAM SILVER, *of Bishopsgate-street, for improvements in colour printing.*—[Dated 14th December, 1864.]

DIFFICULTY and inconvenience have hitherto arisen in the use of caoutchouc for calico printing, in consequence partly of the offensive smell, and partly of the inflammable nature of the solvents used to render it sufficiently liquid for printing purposes,—turpentine, coal tar, and naphtha being the solvents most generally used.

Now the patentees have ascertained that the milk of ballata and the milk of caoutchouc, being both natural productions, and requiring no

solvents to render them fluid, may be employed with advantage in colour printing, and are in great measure free from the objections to which dissolved india-rubber is subject. If the milk as imported is thicker than required for printing purposes, water may be added to it, and the milk reduced to a suitable consistence for use.

The milk of ballata or caoutchouc, either alone or mixed, when strained through sieves or cloth, or other suitable strainers, is mixed with the desired dye or pigment, such dyes or pigments having been previously mixed or ground very fine in water alone, or in paste, size, or gum. When concentrated dyes are used, such as ground logwood, phosphine, roseine, magenta, and indigo, they are diluted with water to the required tone of colour, and then mixed with the milk ready for use. The mode of applying colouring matter to printing rollers and to blocks for printing the process of "tearing," &c., is well understood by persons conversant with this branch of manufacture. Owing to the rapidity with which the milk of ballata and caoutchouc, either alone or mixed, coagulates, care should be taken to have brushes, "tearing" sieves, and cloths, printing blocks, &c., put into water, and washed with clean water when out of use, or the colour cleaned off before it becomes set and hard. In printing on paper, it is preferred that the paper should be unsized or only partially sized; paper hangings for walls, when printed with the ballata and caoutchouc milk, will bear washing with a sponge and soap-and-water.

The patentees claim, "the application of the milk of ballata, or the milk of caoutchouc, alone or in combination with each other and other substances, for the purpose of colour printing, as described."

To WILLIAM CLARK, *of Chancery-lane, for improvements in preparing or treating wood and other vegetable fibrous materials for the manufacture of pulp for paper,—a communication.*—[Dated 10th January, 1865.]

THIS invention relates to the application of aqua regia for the purpose of destroying, dissolving, and effecting the disintegration of all the gummy portions of ligneous matters without injuring the cellular tissue. The colouring matters are also at the same time transformed into pieric acid and chlorated composites, which are easily eliminated by washing, steeping, and the use of chlorine. Long diaphanous filaments are thus obtained, possessing suppleness, elasticity, and strength, which will bear comparison with those obtained from rags. The aqua regia is composed of from five to forty per cent. of nitric acid, and from sixty to ninety-five per cent. of hydrochloric acid. The nitric acid is employed in a raw state, as it leaves the apparatus in which it is made before being bleached. The hydrochloric acid is that used in commerce. The variation in the proportions of the two acids constituting the aqua regia is rendered necessary by the difference in the nature of the coloured and gummy elements contained in the vegetable fibre. Thus, a preliminary trial is indispensable in each case, for fixing the composition of the acid bath. This point being determined, the proceedings are as follows:—

First,—the wood is reduced to shavings, or, in the case of straw or other vegetable matters of small size, to fragments, and dried to prevent any excess of water from weakening the aqua regia. Secondly,—these shavings or fragments are digested in the acid bath until they have

absorbed their weight of the reagent; any excess of acid remaining after this absorption, may serve the same as pure aqua regia for a similar purpose. Thirdly,—the ligneous matters, after being withdrawn from the bath, are washed in plenty of water, and the fibres then separated by means of a vertical mill, similar to those employed in the manufacture of straw paper. Fourthly,—a yellowish brown pulp is obtained, which, after being again washed, may be submitted to the steeping and bleaching operations usual in the manufacture of paper.

The patentee claims, "transforming vegetable matters, and especially wood, into the pulp for paper, by the aid of aqua regia as described."

To Richard Archibald Brooman, *of Fleet-street, for improvements in engraving upon crystal, glass, and silicious substances,—a communication.*—[Dated 11th January, 1865.]

The object of this invention is to produce engravings by chemical means upon crystal, glass, and silicious substances, by the reaction of hydrochloric acid upon the hydrofluates (florhydrates) of fluorides of ammonium, potassium, sodium, and lithium. Thus, by causing the hydrofluates or fluorides of ammonium, of potassium, of sodium, or of lithium to act upon a solution of hydrochloric acid on one hand, and anhydrous metallic chlorides upon a mixture of hydrofluoric acid, and hydrochloric acid on the other hand, engravings may be produced, either by means of printed or hand-drawn reserves, or by the direct application of the said mixtures, by a pen, or brush, or like instrument, upon crystal, glass, and other silicious substances.

The inventors have discovered that, first, the action of hydrochloric acid upon the hydrofluates of fluoride for decomposing these salts, and setting the hydrofluoric acid free, applies also to the action of all the mineral and vegetable acids upon the same fluorated combinations, and to the action of all metalloids and binary bodies capable of forming with hydrogen, hydroacids, such as chlorine, bromine, iodine, cyanogen; second, that this action of all mineral and vegetable acids and of metalloids and binary bodies before named, upon hydrofluates of fluorides is more energetic, when these salts are dissolved in water charged with hydrofluoric acid; third, that the metallic perfluorides, upon contact with the acids, produce, like the hydrofluates of fluorides, engravings upon crystal and glass; fourth, that the hydrofluates of fluorides, perfluorides, and hydrofluoric acid, produce engraving upon crystal and glass when they are placed in contact with oxysalts, or with alloidal, alkaline, alkalino-terrous, terrous, or metallic salts, the acid or metalloid of which may be entirely or partly removed, either by hydrofluoric acid alone, or by perfluorides and hydrofluates of fluorides dissolved or not in hydrofluoric acid; fifth, that the protofluorides capable of decomposition by acids produce, though slowly, engraving upon crystal or glass, when in presence of two acids, one of which combines with the metal or with the oxide of the metal, and the other with the hydrofluoric acid set free; sixth, that this last action is produced also in a mixture of several acids; seventh, that the result from the facts before set forth is, that engraving upon crystal and glass is produced when the crystal or glass is exposed to the action of a copula or double acid (couple acide) resulting from the union of non-nascent hydrofluoric acid with a hydracid or an oxacid in

a nascent state, and inversely from the union of chlorine, bromine, iodine, cyanogen, or of an oxacid, or of a hydracid non-nascent with nascent hydrofluoric acid; eighth, that for the practical use of the reactions above named for producing engraving, it is generally advisable that the crystal or glass to be engraved, should be successively and at frequent intervals dipped; first, in a mineral or vegetable acid, or in one of the before-named metalloids; second, in any of the before-named acid salts, and so on alternately in the above order, or in the inverse order, until the complete production of the engraving be obtained.

The patentee claims, "engraving upon crystal, glass, and silicious substances, First,—by the action of hydrochloric acid upon the hydrofluates of fluorides of ammonium, potassium, sodium, or lithium, as described. Secondly,—by the action of all the mineral and vegetable acids, and of the metalloids and binary bodies hereinbefore referred to upon the hydrofluates of fluorides and metallic perfluorides, dissolved or undissolved in hydrofluoric acid as described. Thirdly,—by the action of hydrofluoric acid, perfluorides, and hydrofluates of fluorides upon alloidal salts and oxysalts, the acid of which may be entirely or partly disengaged by them into the nascent state, as described. Fourthly,—by the action of mixed mineral or vegetable acids upon protofluorides, as described."

To JOSEPH SOLOMON, *of Red Lion-square, and* ALONZO GALORD GRANT, *of Nottingham, for improvements in lamps, or apparatus for burning magnesium, and other metallic substances.*—[Dated 31st October, 1864.]

THE object of this invention is to feed forward, in a constant and regular manner, the wire which produces the light in magnesium lamps. As the light is produced by the combustion of the wire, and this latter gradually burns away, with a certain and uniform speed, according to the thickness of the wire, the feeding forward of the wire in a regular manner, to a given point, so as always to keep the spark or ignited end of the wire at the same spot, is a matter of great importance.

In Plate XI., fig. 1 is a vertical section of the lamp, and fig. 2 is a front elevation of the same.

The magnesium wire is wound upon a spool or spools a, which are placed in a cylinder a^1, mounted on a stand, on which is placed a box, containing the clockwork movement b, which, when in action, draws the wire a^*, off the spool a, and passes it through a tube c, and between a pair of feeding rollers d, d, to a tubular holder e, from the outer end of which it projects, and, when lighted, burns with an intensely brilliant light. This spark or spot of light may be placed in the focus of a parabolic or other reflector f, f, so that the light may be thrown forward in any desired direction. The reflector is inclosed in front by a case f^1, provided with a glass f^2, to protect it from currents of air. The whole apparatus is of an extremely portable character, and is provided with a handle g, whereby it may be carried or held in any position. This handle g, should be cranked, or bent down, so as to form a foot; so that, with the feet h^*, h^*, fig. 2, attached to the outside of the reflector, three rests, or supports, for the lamp will be formed. For some purposes, the spools are dispensed with, and the wire is introduced, at once, to a pair of feeding rollers, which, being actuated

by the clockwork, will carry it forward to the point of combustion. The wires may consist simply of magnesium, or of magnesium wire, twisted or combined, with wires or bands of other metal, such as zinc, cadmium, lithium, strontium, barium, or other metals, or alloys with magnesium. These metals, or alloys, when ignited, burn with different coloured lights, as will be well known to chemists and pyrotechnists; and, therefore, signals for naval, military, telegraphic, or other purposes, may be made with the magnesium, or alloys.

As a modification of this improvement, asbestos, cotton, flax, or other textile substance, capable of absorbing any concentrated solution, or preparation, of the above-named metals, may be combined with magnesium wire or bands. The best preparations for this purpose are the chlorates, nitrates, and chlorides of the metals.

The next improvement consists in adapting to the break, or stopping mechanism *i*, of the clock movement a wedge *j*, which is introduced into the tube, containing the break lever i^1. By inserting this wedge *j*, above the break lever i^1, as indicated by dots in fig. 1, the stop, or break *i*, will be kept out of action when the clockwork is required to be in motion. When the clockwork is to be stopped, the wedge *j*, is to be withdrawn, and the break *i*, will stop the movement.

Fig. 3 is a plan view, and fig. 4 a side view, of another mode of holding the stop lever down. In this instance, the wedge is dispensed with, and the stop lever i^1, is held down by a stud at the end of the flat spring j^1. As the lamp is mounted on three legs, it can be placed on a table or stand, and allowed to remain in any given position without being held by the hand. The tubular wick, or wire holder *e*, is screwed into its place, as seen at e^1, fig. 1; so that, should it become damaged, it may be unscrewed, and removed with facility, and another holder screwed in its place. This tubular holder *e*, should, by preference, be constructed of platinum, or some other metal which is difficult to melt, or the tube may be provided with a platinum nose; the object of this improvement being, to prevent the tube from being fused by the heat of the burning wire. The vapours evolved by the combustion of the wire escape up the chimney *k*, in which an upward draught is produced, by means of a fan or ventilator *l*, fig. 2, which is worked by clockwork, as shown. The reflector case is perforated with holes *m*, *m*, fig. 1, for the admission of air to the combustion chamber. The air, as it is drawn in by the ventilator or fan *l*, will ascend the chimney *k*, and pass down the flue k^1, into a vessel *n*, containing an acid, or other solution, capable of taking up and absorbing the metallic vapours.

The next improvement consists in combining sodium, potassium, or other alkaline metal with magnesium. This alloy will give a red, but strong, heat and light, and will greatly facilitate the ignition of the magnesium or other wire. To adapt this improvement, the alloy of sodium and magnesium is cut up into small pieces, and protected from the atmosphere, by being coated over with varnish, and then wrapped in tinfoil. One of these pieces is attached to the end of the magnesium wire by being squeezed on it, and, when it is required to ignite the wire, this may be done at once by applying thereto a lighted match.

The patentees claim, "the general arrangement and construction of apparatus described for feeding forward magnesium or other wire, to be burned for lighting purposes."

To COWPER PHIPPS COLES, *of Ventnor, in the Isle of Wight, for improvements in apparatus for working and loading ordnance.*—[Dated 14th December, 1864.]

THE first part of this invention consists in the employment, for running guns in and out, of a winch with a chain, which may be placed in front or rear of the gun.

The apparatus for running guns in and out is represented in Plate XII. Fig. 1 is a side elevation, and fig. 2 an end elevation, of the improved apparatus for running guns in and out. A, is a worm wheel actuated by a worm B, on a vertical shaft C, which carries a bevil pinion D, in gear with and driven by another bevil pinion E, on the spindle of which a winch handle F, is mounted. Or the wheel A, may be driven by spur gearing if found more convenient. The shaft of the wheel A, carries a chain barrel *b*, round which, and a chain pulley *c*, an endless chain *a*, *a*, is caused to run. The barrel *b*, may be made to revolve in either direction according to which way the handle F, is turned. The pulley *c*, is firmly attached to a chock *d*, by means of an eye bolt. Beneath the gun carriage G, are lugs *e*, to which what is termed a compressor is pivoted at *f*. This compressor consists of an excentric *g*, on the end of a lever *h*, to which a weight *i*, is attached, to keep the lever *h*, when not acted upon, in a vertical position, and when in that position allow the chain *a*, to run freely over the excentric *g*. *j*, is a chain or cord, which, when hauled on, draws the lever *h*, upwards, and causes the excentric *g*, to bite or grip the chain *a*, so that it becomes, as it were, fixed to the gun carriage G; thus, in whichever direction the chain *a*, is made to travel, the carriage G, will travel with it. Instead of being fitted to work in a vertical plane, as shown, the compressor may be made to work horizontally, and in that case the weight *i*, may be dispensed with. *l*, is a break for arresting the chain *a*, and with it the gun carriage, in any desired position. This break is worked either by a hand lever *m*, or by a treadle *n*, or by a self-acting lever *o*. The upper part of the lever *o*, is struck by the gun carriage, so that the lever *p*, is forced down and the break *l*, acted upon. *q*, is a clutch worked by hand levers *r*, and *s*, for putting the chain barrel *b*, into and out of gear; when out of gear the barrel runs loose upon its spindle. *t*, is a small barrel keyed to the barrel *b*, for working the tripping or other tackle employed; this barrel may be worked in connection with or independently of the barrel *b*. When worked in connection with it, the clutch *q*, is made to fix the barrel *b*, firmly to its spindle; and when worked independently, the barrel *b*, is allowed to run loose on its spindle by putting the clutch *q*, out of gear.

The second part of the invention consists in apparatus for slinging a shot or shell near the centre of gravity for hoisting it up, with the means of fixing it in this sling or bearer, or leaving it free to move on the axis of the cradle and pass into the bore of the gun. Fig. 3 represents a sling for a shot for rifled ordnance. The apparatus is composed of a cradle *a*, to which are fixed two rigid handles *b*, *b*, and a band *c*, which handles and band are somewhat higher than the centre of gravity of the projectile when placed in the cradle, so as to prevent it tipping over. On the necks, by which the handles *b*, *b*, are fastened to the band *c*, a moveable handle or sling *d*, free to revolve is fitted, to

which the chain or pulley, by which the cradle is hoisted up, is hooked. As a further precaution to prevent the shot from turning over and out when suspended by the chain and the handle *d*, claws *e*, *e*, are fitted, so that when up and clasping the handle *d* (as shown by the claw *e*), the cradle cannot rotate on its centre, and the handle *d*, becomes a fixture, preventing any chance of the shot turning out. *f*, is a stand by which the apparatus may be supported in a vertical position, and by which in the case of shells the fuse is protected. When the shot is in the proper position for entering the bore of the gun the claws are released, and from the shot being nearly balanced it is easily turned into position for loading. When the shot has entered the muzzle of the gun the cradle is slipped off and the shot forced home by a rammer in the usual manner. If preferred, instead of the claws *e*, e^1, a pin or a clamp screw may be fitted.

The patentee claims, "First,—constructing apparatus for running guns in and out, composed of a winch and chain, arranged and actuated substantially in manner described. Secondly,—constructing apparatus for slinging shot and shell, substantially as described."

To SAMUEL HOOD, *of King William-street, for an improved method of securing coal plates, applicable to the securing of glazed area gratings, trap doors, and other similar covers.*—[Dated 14th December, 1864.]

THE object of this invention is to secure coal plates from the outside, and that in an easier and more effective manner than is usually done by a chain and staple, or by a staple and crossbar applied from the inside. These means of fastening from the inside are difficult to effect when the cellar is full of coals. The invention consists in connecting to the under side of the plate, at two, three, or more points, hooks or catches, so formed and weighted, that upon the plate being placed on its seat, the engaging part of the hooks shall be forced outwards from the centre, and take hold on the under face of the seat, whereby the plate will be secured from being raised from the outside, until the catches are released from the inside of the cellar.

The figure in Plate XI. is a vertical section of the improved coal plate. It is the same when applied to glazed area gratings, trap doors, and other similar covers. A, is the plate; B, B, B, are three flanges, depending at equal distances from the under side of the plate, and cast with two brackets C, from which depend weighted catches D, suspended from pins E, which pass through the brackets C, and the top of the catch. The catches are made heavy at back, so that the force of gravitation will cause the hook of the catch to project outwards and under the seating. F, F, are projections on the other side of the plate to enter apertures made for their reception in the seating, in order to prevent the plate being turned round or rotated.

The patentee claims, "connecting to the under side of coal plates, gratings, doors, and covers, two, three, or more points, hooks, or catches, arranged and acting substantially as described."

To José Puig y Llagostera, *of the Strand, for improvements in machinery for spinning cotton and other fibrous materials,—being a communication.*—[Dated 20th December, 1864.]

This invention consists in driving spindles by means of a rolling friction from a wheel or drum made of or covered with leather, or other suitable material of sufficient elasticity, and affording sufficient adherence to or against the part of the spindle which is thereby driven. The spindles are driven in pairs—that is to say, two from each wheel or drum—a number of such wheels or drums so actuating their pairs of spindles being driven by bevil or other gearing, or in any other convenient manner. The invention also consists in making moveable (instead of fixed) the steps or bottom bearings in which the spindles revolve, and causing them to be pressed towards the wheels or drums by wedges with weights suspended from them, or by springs, so as to keep the spindles fairly and properly in contact with the peripheries of the drums.

In spinning machinery of the ordinary description, the spindles are furnished with small pulleys, round which pass cords from drums of a large diameter, and which are placed horizontally or vertically in some convenient position, each spindle having a separate driving cord. This arrangement presents several defects, especially with drums placed horizontally; for, in order that it should work conveniently, the upper edge or the lower edge of the drum should be on a level with the groove of the pulley, to enable the cord to run properly in its groove. But the drum being of large diameter, the cord forms a wide or open angle upon the plane of the groove, thereby producing a continual and considerable friction of the cord against the upper or lower edge of the groove, causing loss of power and also a stretching of the cord and consequent irregularity of twist; and this irregularity is increased by atmospheric influences of moisture and temperature, which stretch and relax the cords, and that differently for each, according to its particular quality and the time it may have been in use.

By this invention a perfect or greatly improved regularity of speed and diminution of friction, and of absorbed or lost power, are obtained. The pulleys, cords, and the ordinary drums are dispensed with, and replaced by the arrangement shown in Plate XI., where fig. 1 is a front elevation of a portion of a spinning machine, and fig. 2 a side view of same, partly in section, with the improvement applied thereto. *a*, is a driving shaft, on which are bevil wheels *b*, *b*, in gear with the bevil pinions *p*, *p*, which are cast on, or in one with the lengthened tubular stems or axles of the drums *c*, *c*. These drums are covered each with a leather band *e*, and revolve on pivots *f*, fixed to the arms *g*, *g*, projecting from the frame *h*, which supports the twisting spindles *z*, *z*, of the machine. These spindles, instead of being furnished with pulleys as is usual, are formed with an enlarged cylindrical or roller-shaped and accurately-turned surface *n*, near their lower end, against which the elastic band *e*, of a drum *c*, presses, and by the rolling friction so occasioned the spindles are caused to revolve, each drum driving two spindles; or, if desired, the machine may be arranged for each drum to drive only one spindle. The several spindles rest each at its lower end in a step or bearing *o*, which is carried by the frame *h*, and is free to move to a small extent therein towards and away from the drums *c*, and each such

step or bearing is furnished with a small wedge *i*, from which a weight *i** is suspended, the inclined surface of the wedge bearing against a corresponding surface on the frame *h*, by which means the step *o*, is pressed towards the drum *c*, and consequently the spindle *z*, is kept in proper contact with the elastic covering *e*, upon the drum, the degree of pressure being regulated as may be necessary by using a lighter or heavier weight *i**. The same object, may, however, be attained by springs, or in any convenient manner.

The patentee remarks, "that the disposition of the bevil gearing as represented may be varied, the pinions *p*, being close up, or nearly to the discs of the drums, instead of on the lower ends of lengthened tubular axles, and the driving shaft *a*, and wheels *b*, being raised and placed at the back of the arms or brackets *g*; but if so, the gearing should be hyperboloidal or oblique: or the wheels or drums *c*, may be driven in any other convenient manner."

To JAMES BYRNE, *of Dublin, for improvements in governors.*—[Dated 22nd December, 1864.]

THIS invention consists of an adjustive governor applicable to steam engines or other motive-power engines and machinery. The principle of this governor is, that the centrifugal force of the balls at the extremities of the revolving pendulums is equilibriated at any required speed by the force of gravity of an adjustable counterweight or the tension of a spring, by which means a valve may be actuated or machinery controlled.

The figure in Plate XI. shows a side elevation of the improved adjustive governor, with the valve connections and other adjustments; *a*, is a wrought-iron spindle, having a disc at the base with holes in it, whereby it may be bolted to a similar disc on a vertical shaft of a length dependent on circumstances; *b*, is a bulb forged on the spindle *a*, having two through mortices in it, crossing each other at right angles. In these mortices, four crank pendulums *n*, *n*, are secured by bolts with split pins and washers. The arrangement of the pins in these joints gives mutual security, for even if the split pin and washer of any one of them flies out, the joint pin cannot come out, as the head will come in contact with the point of its successor, which must be backed considerably before it can pass. *c*, is a brass cylinder, moveable vertically on the spindle, which is made hexagon at this part in preference to feather keys. *d*, is an oil hole in the cylinder, which must be left open, as it answers for an air passage also. *e*, is a steel concave centre driven into the top of the cylinder. *f*, is a spindle, the lower end of which fits the concavity of the centre *e*, and is made to slide vertically through the guide *s*, which may be bolted to a bracket or stay from any convenient place. *g*, *g*, *g*, *g*, are four balls, each fixed on its pendulum *n*, by a nut fitted into a recess in the ball. *h*, *h*, *h*, *h*, are four guides for the pendulums, forged on a centre ring, which is keyed on to the disc. The pendulums may be made wider at that part where they pass through the guides, so as to present a good bearing surface. *i*, is a strap bolted to the steam pipe, and forming a bearing for one end of the throttle valve spindle. *j*, is a regulating lever, which is made and adjusted so

as to have an arc of traverse of the same number of degrees as the arc of one of the revolving pendulums. *k*, is an adjustable counterweight on the lever *j*, whereby the different speeds may be controlled, the weight being placed higher up the lever for slow speeds, and *vice versâ*, intermediate points controlling intermediate speeds. A spring balance may be substituted for the counterweight, by attaching it to the regulating lever and a fixed point at any convenient distance. By using the spring balance, the adjustable governor can be applied to marine engines. The governor is instantaneous in its action, for the counterweight maintains a constant pressure on the steel centres, and the intermediate gear is always maintained tight, so that the slightest alteration in the speed is instantly communicated to the valve.

The patentee claims, "the general arrangement and construction of governors, as described."

To James Paterson, *of Dundee, Forfarshire, N.B., for improvements in the treatment of jute and other fibrous substances, and in the machinery, apparatus, or means connected therewith.*—[Dated 23rd December, 1864.]

This invention relates to certain improvements in the construction and arrangement of machinery or apparatus employed for "batching" and softening jute, hemp, or other fibrous substances, whereby these processes are conducted in a more rapid and efficient manner than hitherto.

The figure in Plate XI. is a partial transverse section and elevation of the improved apparatus. *a*, is the framing of the machine, which consists of a rectangular bed at the bottom, to which are fixed the guides B, for holding the bushes C, of three or more pairs of grooved and fluted rollers D, D^1, and D^2, D^3. At suitable distances along the framework A, brackets are fixed for carrying the shafts E, F, and S, by which the rollers D, D^1, and D^2, D^3, are driven. The upper and lower rollers D, D^1, and D^2, D^3, are alternately grooved and fluted, and by the method of arranging the gearing the fluted rollers are driven from the side of the machine opposite to that from which the grooved rollers are driven, and slightly faster than these grooved ones. In the figure one-half of the grooved rollers D, D^1, are shown cut away, and the small spur pins *c*, and *d*, are those which project from and by which the next pair of grooved rollers behind the fluted ones D^2, D^3, are driven; the fluted rollers D^2, D^3, are driven by means of the shaft S, and wheels T, on the other side of the machine. Extending across the top part of the framing is the perforated tube G, which is divided about the centre by the diaphragm H, and at about the centre of each of the halves of the tubes G, a hollow branch I, is formed, connected by the pipe J, to the valve or regulator K, the cross-feed pipe L, extending directly over the top of the machine, having a branch M, at its central part communicating to the reservoir, not shown, and which may be placed in any suitable position. In the top of the framing standards are fixed, at the upper end of which a joint O, is formed, to which is coupled the bent lever P, the lower part of which rests upon the bearings of the upper set of rollers. At a certain part of the hori-

zontal length of the lever P, the plunger or valve Q, is attached; and as the lever is lifted the plunger or valve Q, is also raised, and in proportion varying with the amount of opening which the valve Q, has is the quantity of liquid run upon the jute regulated. A table is fixed on a level with the point of intersection of the fluted rollers upon which the jute is laid for being fed into the softening machine.

The mode of carrying out the invention is as follows:—The machine being put in motion, the jute is gradually drawn forward on the table, and passes between the first pair of rollers D, D¹. The thickness of the layer of jute as it passes through causes the upper set of rollers to be raised, which raising movement is communicated by means of the intervention of the lever P, to the regulator Q. By this means the quantity of oil allowed to fall, as shown at *a*, *a*, on the jute as it passes through is regulated by the quantity of jute so passing.

The patentee claims, "First,—the general arrangement and construction of machinery or apparatus for treating and preparing jute or other fibrous substances, substantially as described. Second,—the application of a softening liquid to be used in combination with machinery for preparing jute and other fibrous substances, substantially as described. Third,—the arrangement and construction of a valve or regulator for governing the supply of the softening fluid, and the means of actuating the same from the raising of the rollers, substantially as described."

To EDWARD SAUNDERS, *of Bridge-street, Westminster, for improvements in affixing armour plates to vessels and other structures, and in bolts, screws, spikes, and rivets to be used for these and other purposes,—being a communication.*—[Dated 23rd December, 1864.]

THIS invention relates to the use of screw and other bolts, spikes, and rivets of novel construction for general fastening purposes, and amongst others the fastening or securing of iron and armour plates to marine and other batteries, ships of war, and other vessels, in lieu of the solid metal bolts, spikes, and rivets hitherto used. When solid bolts are used in affixing plates of iron to the above structures, they are liable to be either driven through or shattered or broken by the impact of heavy projectiles; this liability increases as the size and consequent rigidity of the solid bolts is augmented, as in the case of thick and heavy plates, in fastening which it becomes necessary to increase the size of the bolts, in order that they may support as well as fasten the same to the under work. To remedy the above defect in these fastenings is the object of this invention, which is accomplished by making the body, shank, or centre part of the bolt, spike, or rivet of a number of wires, rods, or strands twisted, or so placed together that in transverse section they shall possess the required tensile strength, and at the same time a considerable degree of elasticity, and to make the heads and ends or points solid, by beating and welding, hammering, or compressing the same.

The figures in Plate XI. illustrate several forms of the improved bolts, spikes, and rivets, in making which a good piece of wire rope is employed, the same being cut to the required length, and the heads and points or ends are forged solid. Instead of welding or forging the wires to form the head of the bolt, they may, in some cases, be spread

out, and wedges driven in to spread them from the outside, so as to cause the whole mass to conform to the tapering hole in the plate, and then to cover it, if necessary, by any suitable kind of metallic or other packing.

The patentee claims, "the method of constructing a screw bolt, blunt bolt, spike, or rivet of wire or rods of any shape, in such manner that with a solid end, with or without thread, and solid or proper head, the shank or intermediate portion shall retain a certain degree of elasticity not possessed by any ordinary solid rivet, spike, screw, or bolt."

To Edmund Morewood, *of Cheam, Surrey, for improvements in coating metals.*—[Dated 24th December, 1864.]

In the operation of coating sheets or plates of metal with melted coating metal, it is very important (especially when one kind of flux is used on the surface of the coating metal on the entrance side of the bath of melted metal, and another kind of flux or no flux at all on the exit side) to have such an arrangement as to free the surface of the plate or sheet from any of the flux which may cling to it as it passes into the coating metal from the flux on the entrance side, and to prevent (as far as possible) any flux or foreign matter from travelling with the sheet under the coating metal, and to that part of the bath from which the plates make their exit. In order to accomplish this, the lower part of one or both sides of the flux box is made moveable, or turns on a hinge in such a position that, when at rest and closed, one point of each side of the lower part touches a point of the other side of the flux box, as shown in section in Plate XI. at fig. 1, where *a*, represents the flux box, and *b*, the side that is hinged at the point *c*. The points which touch are below the surface of the coating metal, and placed so far below, that when the plates are put into the flux box such plates are immersed in the coating metal when resting on the bottom of the flux box, and if the flux box be in a dipping bath of tin or terne metal for ordinary-sized plates, they will be wholly immersed in such metal; but if the coating metal be other than tin or terne metal, say, zinc, or the sheets of very large size, such sheets may be only partially immersed in the coating metal when they begin to pass out through the moveable part of such flux box. The hinged or moveable part of the side is also so far below the surface of the coating metal that the upper portion, which is stationary, is sufficient to confine the flux within the flux box. When the sheets are pressed down through the bottom of the flux box they make their entrance into the melted metal by pushing the moveable side or sides sufficiently apart from each other to allow them to pass, or these sides may be pushed apart by means of a lever, as shown at *d*. The lever may be worked either by hand or by a weight suspended from the lever, which should be so regulated that the weight and pressure of the plates on the moveable sides would cause those sides to part asunder, and allow the plates to enter into the melted metal. By this means the plates are retained a short time within the flux box, and under the coating metal. To enable the plates or sheets readily to push apart the moveable side of the flux box, the bottom edge of the moveable side is made of half-round wrought iron, the somewhat

rounded part being presented to the surface of the plate as it passes out or brushes by it.

In coating iron with tin or lead, or zinc, or their alloys in a melted state, by means of rollers, the sheet in passing through the flux into and under the coating metal is apt to draw down with it some of the flux or foreign matter, and either to deposit the same on the rollers as it passes between them, especially between the first or second pairs, or to get such foreign matter more or less pressed on to the surface of the iron by the nip or bite of such rollers. In order to avoid this as much as possible, the improved apparatus is employed for transmitting or passing the plates or sheets through the bath of coating materials to the part where they make their exit, or are extracted.

Flutes or grooves are made in the pairs of rollers between which the sheets first pass after being immersed under the surface of the coating metal, such grooves being of the depth of about three-quarters of an inch, and to the breadth of about two inches, with an interval of about one inch between each groove or flute, the diameter of such rollers from top of projection to top of projection being four inches. These flutes are made to circle round the rollers, and the flutes and projections of each roller of the pair are so arranged that when the pair are revolving, the projections of one of the pair are opposite to and meet the projections of the roller of the other pair, and the grooves and flutes are opposite to and meet the grooves or flutes in the other roller, of the pair. The fluted or grooved rollers, which are supported in bearings, only bite or touch the sheets where the projections of each roller of the pair meet one another, and no pressure is given to those parts of the sheets which pass between the grooves or hollows.

Another mode by which the same object is attained is as follows:—The first two pairs of rollers are arranged as shown in section at fig. 2, so as to effect what may be termed an alternately over and under action upon the sheet or plate. By this means pressure to both the upper and under side of the same part of the sheet passing between the pairs of coating rollers is avoided, although the revolution of such pairs of rollers causes the plate to travel when passing between them in the desired direction; and the right travel of the sheets by means of guides is insured.

The improved apparatus for providing properly for the exit or extraction of the plate or sheet is arranged as shown in section at fig. 3, where *a*, *b*, is the last or finishing pair of rollers (working in contact with coating metal) through which the sheets or pieces of iron in process of coating make their exit from a bath of coating metal. The rollers are so arranged that they work under the surface of the melted coated metal at such a depth (although their tops are above the surface) that the coating metal rises above the centre or nip of the finishing rollers so far as to form a supply or channel of melted coating metal above the nip or centre of such rollers, and through that channel the sheets pass out of the bath after leaving the nip of the finishing rollers. By passing the sheet or plate out through a channel of coating metal, after leaving the nip of the finishing rollers, those parts which may have been imperfectly covered or which may have had their surfaces of coating too much thinned in passing through the

nip of the finishing pair of rollers, obtain a further coating of the melted metal.

Another advantage attending this arrangement is, that the finishing rollers, in their revolution through and out of the melted metal, bring up (especially in the case of tin) and carry over as they revolve that which is technically called "scruff" upon their upper surfaces; and as such upper parts of the rollers in revolving re-enter the coating metal on the side away from the nip, they leave the "scruff" on the surface of the bath of melted metal on the outer side of each roller. The "scruff" can easily be collected and withdrawn from that part by means of a flattened rod of iron or other suitable means. By this arrangement the rollers act the part of scavengers to the channel of coating metal which is between them and immediately above their nip.

It should be observed that it is not advisable, in coating sheet metal, to keep a flux on the surface of this channel of melted coating metal unless the means of removing it readily from the surface of the coated plates is provided. On the exterior side of the finishing rollers *a*, *b*, is kept a suitable flux, as tallow or grease, for tin or terne metal, as represented at *w*, *w*. In some cases, where a ready means of removing the flux from the surface of the coated sheets is available, a flux is used upon the channel of coating metal, as such flux causes the sheets to travel out rapidly and brings out a thinner coating of metal on their surface than if the sheets came out through clear metal.

In coating with tin or terne metal, when it is desired to prevent the sheets bringing out on their surface any flux or grease, they emerge or are extracted from the channel of such melted metal, no flux is used on the channel of such melted metal between the finishing rollers; and the surface of the channel is kept about two inches above the nip or centre of those rollers. In coating with zinc, a layer of fine sand is used, slightly damp, on the channel of melted zinc between the finishing rollers, and muriate of ammonia on the exterior side; but if the sheets in process of coating follow one another steadily and rapidly, such channel of melted zinc is uncovered, and in that case a flux of sal-ammoniac on the surface of the melted zinc is employed on the exterior sides of the finishing rollers. In coating with tin, when it is desired to make rapid work in order to keep the channel of melted metal through which the sheets emerge after leaving the nip of the rollers clear of scruff and foreign matter, an oblong box *c*, is used, in addition to the rollers which act as scavengers. This box is made of wrought iron, open both at the top and bottom in the said channel of melted coating metal, the lower ends of which converge. The sheets in process of coating pass up from the nip of the finishing rollers into and through the narrow opening at the bottom of this oblong box, being guided into it by means of small guide pins *d*, about an eighth of an inch in diameter, projecting outwardly below the bottom of the box, so as to insure the entrance of the sheets into such box. This oblong box is made, at the end where the sheets enter, of about a quarter of an inch in width, extending lengthways along the oblong box or trough, which widens out towards the top, where the opening is from about an inch and a half to two inches wide, and the sides of such box are made so as to yield readily to the pressure which may be caused by sheets of more than ordinary thickness passing between

them. If it be found that there is more impurity in the coating metal than is got rid of by the last-described modes, an oblong box of like character is also placed between the rollers which are next below the finishing rollers. When finishing rollers are used with a channel of coating metal above their nip, as before described, such rollers are made of about six or eight inches diameter, so that they may form a kind of heated wall above the surface of the melted metal which does not rise above the nip of the rollers to nearly the level of their upper surfaces. By using rollers of this diameter, the advantage of passing the sheets or plates, on their emerging from the bath of coating metal, into a stratum of heated air, is obtained: this assists the melted coating metal in arranging itself evenly on the surface of the sheet or plate and gives more opportunity to the superfluous melted metal to quit the sheet or plate as it makes its exit, and to give a steady and upright motion to the sheets or plates. These finishing rollers should be made hollow. Guides and guiding rollers *e*, *e*, as shown, may also be used, so shaped and placed as to cause the plates to enter between the finishing rollers less curved. These rollers are capable of adjustment by screws or otherwise. In order effectually to prevent the rollers from retaining on their surface scruff, oxide, flux, or foreign matter which they might place on the surface of the plates in process of coating as they pass up between the nip of such finishing rollers, scrapers or brushes are employed, as shown at *f*, *f*.

As it is most important (especially when coating with melted lead or tin) that the motion of the finishing rollers should be very steady and even, and that there should be as little jolt or jar or waving of the coating metal in the channel as possible, a cog wheel *a*, is used, working in combination with a friction wheel *b*, as shown in fig. 4. The friction wheel in this case makes the motion of the cog wheels steady and regular.

In the specification of patents granted to the present patentee, dated the 14th January and 7th August, 1863, a preparatory flux or cleansing fluid bath is described, through which the sheets travel before entering the first coating metal bath, in order to make such sheets or pieces in a fit state to take the coating metal readily, whether such sheets are to be coated by the dipping or roller process. Now it has been ascertained that, in using such preparatory flux in coating metals, a great improvement is effected by employing a vessel made of a metal negative to tin, such as copper instead of iron, for the purpose of containing such preparatory flux; and when rollers are used to assist the transmission of the sheets through such preparatory bath of flux or cleansing fluid or thence to the coating metal, they should be made of copper in the place of iron. When the copper pan is three-quarters full with the preparatory solution hereinafter described, the sheets are placed in the fluid, and then sufficient chloride of copper is added from time to time to cause the plates, when they emerge, to have a slight film of the copper or salt of copper on their surfaces. Wood or other material may be used in making this vessel, if copper forms such portion as to come in contact with the cleansing fluid.

In coating with tin, lead, or the alloys of tin and lead, the preparatory fluids or flux used in the copper pan should be a solution of chloride of tin—that is, tin dissolved in the muriatic acid of commerce—

until the acid is completely neutralised by the tin, and two quarts of water is added to each pint of solution. When coating with zinc, a solution of chloride of zinc is used, adding thereto $\frac{1}{10}$th by measure of sal-ammoniac in solution, and also adding to each pint of this solution two quarts of water. When coating with an alloy of tin and zinc, or of tin, lead, and zinc, the same preparatory liquid or fluid flux is used as in the case of coating with tin, lead, or the alloys of tin and lead, these preparatory fluids being heated at about 150° Fahr.

In employing for coating metals a bath of melted metal, as above described, it is found that it is a great improvement to use a pan or vessel *z*, made of crucible earthenware, capable of bearing the heat, and placed as shown at fig. 2, so that it rests upon and penetrates more or less into and under the surface of the coating metal. This additional pan is filled with sand or other matter, which, being a slow conductor of heat, causes the heat to be retained in the bath of heated metal, and prevents as far as possible the loss of heat, by radiation from the surface. By thus retaining the heat, the necessity of applying a high degree of heat to the outside of the bath, and the loss of metal by evaporation, are to a great extent obviated, the larger bath containing the pan is not destroyed so quickly, and the heat is kept throughout the entire quantity of melted metal equably at the requisite temperature.

The pan *z*, used for the sand is so placed in relation to the rollers, or guiding frame, that the sheets can have a long travel through coating metal, and at the same time the pan is out of the way of the rollers and guiding frames. This pan may be readily applied to other descriptions of vessels used for containing coating metals.

The patentee claims, First,—the general combination of parts forming the apparatus, combined and arranged as described. Secondly,—the apparatus used for introducing the sheets or plates into the bath, and also that used for transmitting them through the bath, and also that used for providing for their exit or extraction from the bath, as described. Thirdly,—the use of a copper bath for containing the preparatory fluid flux, and also the copper rollers, whereby such sheets are conveyed through the preparatory fluid flux bath as described, or between it and the coating metal, as described. Fourthly,—the use of an inside bath or pan containing sand or other non-conducting matter, applied as described.

To CHARLES HENRY TAYLOR, *of Birmingham, for improvements in machinery or apparatus for preventing accidents in mine shafts, and for other like purposes.*—[Dated 24th December, 1864.]

THIS invention relates to the prevention of the descent of a skip or cage in a mine shaft on the accidental breaking of the chain or rope to which the skip or cage is connected. The invention may also be applied to the prevention of accidents in ascending lifts used in warehouses, hotels, and elsewhere.

In Plate XII. fig. 1 represents in elevation, partly in vertical section, apparatus constructed according to this invention to be applied to a skip or cage in a mine shaft for preventing its descent on the acci-

dental breaking of the chain or rope by which the skip or cage is raised and lowered, and fig. 2 is the plan of the same.

a, a, are two parallel racks situated at opposite sides of the mine shaft, and extending from top to bottom of the shaft. The racks *a*, are connected to the guides *b, b*, between which the cage to be raised or lowered in the mine shaft works. To this cage a box *c*, is connected, containing the mechanism for preventing the descent of the cage on the breaking of the suspending rope or chain. The box *c*, i connected to the rope *d*, for raising and lowering the cage in the manner represented. At either side of the box *c*, and opposite the racks *a*, is a toothed wheel or pinion *e*, the axle *f*, of which works in bearings carried by the uprights *g*, fixed to the base of the box. The teeth of these toothed wheels or pinions *e*, are constantly in gear with the teeth of the racks *a, a*. On the axle of each of the toothed wheels *e*, is a ratchet wheel *h*, and between the ratchet wheels are two vertical levers *i, i*, turning on the common centre i^3. The upper ends of these levers are made into pawls i^2, which can be made to engage with the ratchet wheels *h*, or be lifted therefrom at pleasure. This is effected by the sliding horizontal wedge *k*, working on the base of the box *c*. When the wedge *k*, is in the position represented, the lower ends of the levers *i*, are not acted upon by the wedge, but the ends are pressed inwards by the springs *l*. The pawls i^2, at their upper ends, are thereby made to press upon the ratchet wheels *h, h*. When the wedge *k*, is moved outwards by pulling the ring k,^{2} the wedge is made to operate upon the lower ends of the levers *i*, and press them outwards and thus raise the pawls i^2, from the ratchet wheels *h, h*. The wedge *k*, is maintained in its withdrawn position by a spring bolt *m*, entering a recess *n*, in the side of the wedge. By pressing upon the spring bolt *m*, its end is withdrawn from the recess *n*, and the wedge is moved to the position represented by the springs *o*, and the pawls i^2, are again made to engage with the ratchet wheels *h*, by the action of the springs *l*, on the ends of the levers *i*. The direction of the teeth of the ratchet wheels *h*, and the positions of the pawls i^2, with respect to the ratchet wheels, are such that when the pawls are in gear with the ratchet wheels, the toothed wheels *e, e*, can rotate in the direction impressed upon them by the rising cage, but are incapable of rotation in the contrary direction. The parts of the mechanism being in the positions represented, the cage is ready to ascend the mine shaft. Should the rope *d*, break, the cage is suspended between the two racks *a, a*, by the pawls i^2, preventing the rotation of the ratchet wheels *h*, and toothed wheels *e*, in the direction necessary to permit the descent of the cage. When the cage has ascended to the top of the mine shaft, the sliding horizontal wedge *k*, is withdrawn and fixed in the manner already explained, so as to throw the pawls i^2, out of gear with the ratchet wheels *h*. The toothed wheels *e*, can now turn in either direction, and the cage is at liberty to descend the mine shaft. When the loaded cage is about to be raised, the attendant at the bottom of the mine shaft withdraws the spring bolt *m*, when the pawls i^2, are made to engage with the ratchet wheels, and the cage can be raised without risk of accident on the breaking of the chain or rope. The arrangement of parts already described only prevents the descent of the rising cage by the action of the pawls i^2, on the ratchet wheels *h*.

When, however, the pawls i^2, are lifted from the ratchet wheels *h*, to permit of the rotation of the toothed wheels *e*, for the descent of the cage, the rotation of the toothed wheels *e*, is prevented, and the cage is suspended in case of accident to the rope by means of the toothed slide *p*, situated between the toothed wheels *e*, and working through a slot in the top of the box *c*. The slide *p*, consists of a wedge-shaped plate having teeth on either side, the teeth being capable of engaging with the teeth of the toothed wheels *e*. The toothed slide *p*, is suspended in the manner represented to the rope *d*, by which the cage is raised and lowered, and the slide *p*, is pulled down when it is at liberty to move by means of a coiled spring. On the descent of the cage in the mine shaft the toothed slide *p*, is suspended by the tightened rope *d*, in the position represented, and the toothed wheels *e*, *e*, are free to rotate. If, however, the rope *d*, breaks, the tooth slide *p*, is suddenly pulled down by its spring, and engaging with the toothed wheels *e*, *e*, prevents their rotation and thus suspends the cage in the mine shaft. The toothed slide described may also be used for preventing the rotation of the toothed wheels in case of accident to the rope, either when the cage is ascending or descending the mine shaft.

In this case it is preferred to arrange the parts so that the ratchet wheels *h*, *h*, pawls i^2, and sliding wedge *k*, are dispensed with, the box *c*, containing only the toothed wheels *e*, which gear with the vertical racks *a*, and a toothed slide which works through the top of the box *c*. It is suspended to the rope by which the cage is raised and lowered in a manner similar to that represented in fig. 1, and is pulled down when at liberty to move by a coiled spring. When the cage is making its ascent or descent in the mine shaft, the toothed slide is raised by the tightened rope from the toothed wheels *e*, and the toothed wheels are free to move in either direction, and to work upon the racks *a*. In case the rope breaks, the toothed slide is pulled down by the action of the coiled spring, and made to engage with the toothed wheels *e*, and prevent their rotation, and thus arrest the descent of the cage.

The patentee claims, "First,—the general arrangement or combination of the parts described for suspending the skips or cages used in mine shafts, and lifts used in warehouses, hotels, and elsewhere, in case of the accidental breaking of the chains or ropes by which the said skips or cages and lifts are raised and lowered. Secondly,—the general arrangement or combination of the parts described suspending the skips or cages used in mine shafts and lifts used in warehouses, hotels, and elsewhere, in case of the accidental breaking of the chains or ropes by which the said skips or cages and lifts are raised and lowered."

To JAMES PETER ROBERTSON, C.B., *Colonel in Her Majesty's Army, for an improved connector applicable to bales used in cavalry stables, and other purposes.*—[Dated 24th December, 1864.]

THIS invention has for its object the connection of the ends of the bales, ordinarily used in cavalry stables for separating horses, with the ropes or chains to which they are suspended, in such a manner as to admit of the connection between the bale and the rope or other means of suspension being readily broken and re-formed as may be required.

This invention is illustrated in Plate XI. A, is the upper link of a connector used vertically; B, is the lower link of the same; C, is a ring or hollow ball for uniting the link together. The link A, has a portion cut off of its lower end diagonally as shown, and a groove or cavity D, for the purpose of receiving the tooth or projection E, formed on the link B. These two links are respectively formed in such a manner that when they are brought together, they form a cone, which is covered by the ring or hollow ball C, in order to prevent the lateral displacement of the ends of the links. The ring or hollow ball is made to fit, so as to have a bearing a slight distance above and below the junction of the links at the bottom, but it covers the remaining portion of the joint loosely, or so as to afford play, in order to prevent the ring from having too much hold on the joint. F, is the eye at the upper end of the link A, for attachment to a suspending or connecting rope or chain, and G, is the eye at the lower end of the link B, for a similar purpose.

When the connector is applied to bales used in cavalry stables, the eye F, is fastened to the ordinary suspending rope, and the eye G, to the short length of the rope or chain to which the bale is connected, and the connection is maintained by the continuance of the ring or hollow ball C, by its own gravity, when the connector is used vertically as in this case; but when it is used horizontally, a spring or other well-known means may be employed to keep it in its required position, and a lever or levers or other suitable mechanism may be employed to move it as required.

The patentee claims, "First,—the application to bales used in cavalry stables of connectors composed of two links, respectively formed as described at the ends which are brought together, such ends being secured against lateral displacement as required by a covering ring or hollow ball, as described; and, Secondly,—the use of such connectors either vertically or horizontally, for other purposes, as described."

To JOHN WOLSTENHOLME, *of Ratcliffe, Lancashire, for an improved implement for cutting pipes and bars of metal.*—[Dated 26th December, 1864.]

THIS invention relates to the cutting of pipes or bars of metal by means of a circular cutter revolving in a bush, which slides on a hooked piece of steel or other metal. The invention is illustrated in Plate XI., where fig. 1 is a front view, and fig. 2 a plan, partly in section, of the improved implement for cutting pipes and bars of metal. *a*, is a section of a pipe which is supposed to be partly cut through, and *b*, is the hooked piece forming the upper part of the improved implement; *c*, is the cutter revolving in the bush *d*, which slides on the side of the piece *b*, the lower end of which is screwed like a nut. In the lower part of the bush *d*, is a recess to receive the end of the handle *e*, the bush and handle being connected by the pin *f*, fitting in a circular groove in the end of the handle, the upper part of which is screwed into the piece *b*. The mode of operation is as follows:—The pipe or bar to be cut is securely held in a vice, or otherwise, and the circumference of the cutter *c*, is brought against the circumference of the pipe or bar

by turning the handle *e*; the implement is then turned round and the cutter is gradually set up by turning the handle *e*, until the pipe is completely cut through, or until the cutter has penetrated the bar to the required extent; the screw *e*, is then turned back to liberate the implement, and the bar in which the groove has been cut can then be broken in two by a slight blow. Fig. 3 represents a modification of the invention: in this case, the circular rotating cutter *c*, is replaced by a stationary cutter fixed in the bush *d*.

The patentee claims, "the improved implement for cutting pipes and bars of metal, as shown and described, and particularly the rotary cutter *c*."

To THOMAS SLOCOMBE HALL, *of Truro, Cornwall, for improvements in gas-burners.*—[Dated 28th February, 1865.]

THIS invention relates, first, to argand burners, and is intended to effect a more perfect combustion of the gas, and consequently greater economy of the gas than in burners of the ordinary kind.

In Plate XII., fig. 1 is a section of the improved gas-burner. The improvement consists in adapting to the central aperture thereof an adjustable button or disc *a*, which will have the effect of regulating the supply of air to the flame, and of deflecting it in such a manner as to cause a proper combustion of the gas. Air to the outside of the flame is made to pass up through a perforated metal plate *b*. The adjustable disc or button *a*, is mounted on the upper end of a vertical rod or pin *d*, which is provided at its lower part with a toothed rack, into which gears a pinion *e*, whereby the rod and disc may be raised or lowered as required, or the rod *d*, may be screwed, and raised and depressed by turning a milled head below. The arm *d*, may also be raised or lowered, by being attached to a curved bar, which is inserted in a slot or socket, in a piece forming part of the gas pipe, in which it is capable of being moved up or down, and of being fixed in any desired position, by means of a set screw. To prevent sudden currents of air from affecting the flame, two discs or plates are employed: the upper one *a*, is provided with three projecting points which will keep it central in the opening; the second disc a^1, is made of perforated metal, and is placed below the regulating disc, in order to prevent the wind from injuriously affecting the currents of air. If thought desirable, the discs *a*, and a^1, instead of being made adjustable, may be fixed at once into their proper places in the burner. Another form of burner, and which is particularly applicable for producing jets of flame for blowpipe purposes, is shown at fig. 2, and consists in making a circular aperture for the issue of the gas, and converting it into an annular aperture, by the addition of a central tube, through which a jet of air is forced into the centre of the flame in the same direction as the gas is issuing from the annular opening. *i*, is the outer tube, which is supplied with gas through the opening i^1. The gas issues from the nozzle of the tube *i*, from the annular aperture where it is ignited. The jet to form the pencil of flame from the ignited gas is produced by the internal jet *j*, which may either be given from the mouth of a workman through a suitable pipe *k*, or may be produced by a blowing apparatus.

The patentee claims, "the mode herein set forth of regulating the supply of air to the internal part of the flame of burners."

To George Frederick Ansell, *of Bernard-street, Russell-square, for an improved mode of, and apparatus for, ascertaining and indicating the presence of explosive gases.*—[Dated 9th March, 1865.]

The object of this invention is, to provide a certain means of indicating the presence of inflammable or explosive gases in mines, in buildings, and in the holds of ships. This is effected by applying the natural law, known as the diffusion of gases, and relying upon the endosmosis action of the gas, whose presence it is desired to make known, to give a visible or audible indication of its presence, and, when desired, of indicating the percentage of the gas that is present in the atmosphere.

In Plate XII., fig. 1 shows in elevation an instrument for giving an audible signal of the presence of an admixture of carburetted hydrogen with the atmosphere of a coal mine, or other confined space. This instrument consists of a frame A, or, preferably, a compound metal standard, to allow for difference of temperature, from the bed of which rises an adjustable cup B. Upon this cup is placed an india-rubber ball C, inflated with air, and bound round the middle by an inelastic band, to prevent it from expanding laterally. On the top of the ball is laid a cap D, to which a crank lever D^1, carried by a cross-bar A^1, is jointed. The upper end of the lever D^1, is cranked, to enter between the teeth of a crown wheel E, which is mounted loosely on a spindle F, pendent from the cross-bar A^2, of the framing, and thus serves as a stop to that wheel. The under face of the crown wheel is provided with ratchet teeth, which are intended to operate on the tail of a hammer G, and cause it to strike a bell H, set on the top of the frame A, the propulsion of the hammer against the bell being effected by a spring placed under the tail of the hammer. Mounted loosely on the spindle, which carries the crown wheel E, and set immediately above it, is a bobbin I, upon which is wound a weighted cord, having its pendent end laid over a guide pulley K. This bobbin carries a ring of ratchet teeth, into which a click carried by the crown wheel takes, for the purpose of coupling the wheel and bobbin together. When this instrument, arranged as shown, is exposed to carburetted hydrogen gas, the tendency of that gas will be (acting according to the law of the diffusion of gases) for it to pass through the pores of the inflated ball C, and mingle with the air contained therein; and in doing so, the ball will expand, by reason of an increased internal pressure, to which it is subjected. The effect will then be, to force up the cap D, and thereby release the crank lever from the teeth of the crown wheel. The wheel being now free, the weighted cord will immediately commence to rotate the bobbin I, and with it the wheel E, which, through its ratchet teeth, will set the hammer in rapid vibration, and cause, through the hammer spring, a succession of blows to be struck upon the bell, thereby indicating the presence of danger.

The patentee remarks, that the manner of obtaining an audible or visible indication of the presence of carburetted hydrogen gas in a

mine or elsewhere, may be greatly varied; but in all cases the same principle of action will obtain.

Fig. 2 shows, in sectional elevation, an instrument for indicating a sudden irruption of gas in a mine, and transmitting an audible or other signal to a distant part, by the aid of electricity. In this instance, an inverted jar or vessel A, is used, composed of porous earthenware, like the cells of an ordinary galvanic battery, or of graphite, in lieu of the india-rubber ball, for containing atmospheric air. This jar A, is placed upon the wooden bed B, of the instrument. Within this jar is placed a bent mercury tube C, the upper end of which projects through the top of the vessel, and is open to the atmosphere. The tube is filled to a suitable height with mercury, and upon the surface of the mercury, in the projecting limb of the tube, a float of metal rests, its weight being counterbalanced by means of a weighted cord, to which it is attached. This cord is wound round a barometer wheel D, the axle of which may be fitted with a pointer for showing, on a graduated metal disc E, when danger is approaching. Keyed to the axle of the wheel D, is an excentric F, upon which rests a rocking tube G, containing a loose ball, which is free to roll from one end to the other for that purpose, and yet serves to retain the tube when not disturbed in its elevated position. There is metallic contact with this tube and the disc E, produced through the bracket bearing. A covered wire H, soldered to the disc E, leads down to a metallic coupling H^1, on the bed of the instrument; and secured to a metal plate I, which serves as a rest for the rocking tube G, when depressed, is a covered wire I^1, which leads down to a metallic coupling I^2, on the bed B. The metallic couplings H^1, and I^2, are intended to receive the electric wires from a battery, in connexion with an electro-magnetic alarum apparatus, situate at some distant part of the mine, or it may be above ground. Supposing, now, the instrument to be properly coupled, and a sudden irruption of gas to occur, the porous vessel will absorb a portion thereof, and the consequent increase of the pressure within the vessel will cause a displacement of the mercury. The float will thus be raised, and the wheel D, turned, and with it the excentric F. As the larger diameter of the excentric comes round, the tube G, will be tipped over into the dotted position, and the electric circuit will be immediately completed in the instrument. The alarum apparatus within the battery circuit will then be set in action, and the attention of the attendant will be directed to the point of danger. The electro-magnetic alarum apparatus may be of any approved construction.

The instrument shown at fig. 1 may also be readily brought within a battery circuit; the apparatus shown in dots in that figure, or any other well-known arrangement, being introduced into the instrument for the purpose of setting an electro-magnetic alarum in action. For indicating, in a very simple and efficient way, the percentage of carburetted hydrogen gas mixed with the air, the instrument shown at fig. 3 may be used. It consists merely of a bent glass tube A, mounted on a pedestal B; one limb of this tube is graduated, and the other is expanded at its upper end into a cup C. Cemented into this cup is a porous disc D, and the bend of the tube is filled with mercury, or other suitable fluid, to the graduation zero at which it will ordinarily stand. When the instrument is presented to an atmosphere containing

carburetted hydrogen, it will indicate the percentage of gas present by entering the cup c, and causing the mercury to rise (under the increasing pressure to which it is exposed) up the graduated limb of the bent tube.

In order to adapt the invention to the use of mine inspectors, the patentee modifies the ordinary aneroid barometer, by inserting in the back thereof a porous disc, which, when exposed to the atmosphere of a fiery mine, by the removal of a metal cap, will allow the atmosphere to enter the instrument, and act upon the corrugated chamber, and thereby indicate the presence of fire damp.

The patentee claims, "applying the principle of the diffusion of gases to indicate the presence of inflammable or explosive gases, by adapting to suitable indicating apparatus a porous air vessel or chamber, in which the volume of the inclosed air may be increased in the manner and for the purpose above described."

To THOMAS SKIDMORE, *of Wolverhampton, Staffordshire, for improvements in the construction of safes, or receptacles for securing and protecting valuable property.*—[Dated 7th April, 1865.]

IN the manufacture of fireproof safes for the protection of valuable property, it has been the practice to throw the bolts into recesses, formed in the fireproof chamber, which is made of thin sheet iron, and it has been found that, by driving in a metal wedge at the point where the door shuts into the safe, or using other force, the door will give way easily, and a space will be made, so as to admit of a crowbar being introduced between the frame of the safe and the door, which may then be forced open. The side of the safe will be forced out by the wedges, and when the crowbar is applied to the edge of the door it can be forced open, and will bring the lining with it.

To obviate this, an obstacle is interposed to the insertion of the wedges, by constructing the safe in the manner shown in partial sectional plan view in Plate XII. Around the inside of the safe is placed a strong frame *a*, *a*, constructed of angle iron about three inches wide. This angle iron is not cut through at the corners, but only cut away sufficiently to admit of bending the iron down and making it mitre. This angle iron, which forms an inner framing, is tenoned into the body of the safe, and may be formed in two parts, which join half way down the side of the safe; it is firmly secured to the safe all round, by means of bolts or screws. A frame *b*, *b*, of solid iron, about three inches wide by half an inch thick, is dovetailed together, and placed on the angle iron frame *a*, which is tenoned into the safe as above mentioned. The framing *a*, and *b*, and the sides *c*, *c*, of the safe are thus firmly secured together, and on this frame *b*, is placed a steel plate *d*, which fits into a groove in the body plates of the safe one quarter of the way through, and is made flush on the inside with the iron plate *b*. On the front of this steel plate *d*, another plate *e*, of quarter-inch iron is fixed, so as to form, with the steel, a rebate all round the safe. The whole of this is firmly screwed and rivetted to the angle iron and body plates. The door *g*, of the safe is also rebated, so as to fit the inner rebate of the frame before mentioned: it will therefore be evident, that, by inserting wedges anywhere round the edge of the door, the wedges will come in

contact with the hardened steel plate *d*, and cannot be driven in. The front of the safe will also be so strengthened by the strong iron frame *b*, and angle-iron frame *a*, that it cannot be forced out by wedging. The interior capacity of the safe will not be decreased by this arrangement, as all the parts are arranged within the space required by the fireproof chambers *f*, *f*. The door *g*, and side plates *c*, of the safe are made drill proof, by means of hardened steel plates, so that the whole of the safe will be proof against any external violence.

The patentee claims, "the combination of parts *a*, *b*, *c*, *d*, and *e*, whereby the front of the safe is very greatly strengthened, and the possibility of introducing a wedge between the edge of the door and the frame is effectually prevented, as set forth."

To Archibald Turner, *of Leicester, for improvements in looms for weaving.*—[Dated 11th April, 1865.]

This invention relates, first, to an improved method of actuating the batten of the loom, so as to shorten its motion and obtain a "dwell" by means of which the greater part of the friction of the reed upon the warp threads is taken off during the passage of the shuttle through the shed. The mode of carrying out this part of the invention is shown in Plate XII., at fig. 1, which is a sectional elevation of so much of a loom as is necessary to explain the improvement. The batten is shown in its most backward position—that is, at the "dwell"—during which the shuttle is passing through the shed. The batten is shown in the the same figure, by dotted lines, in its most forward position. It will be seen that, instead of connecting the batten *a*, to the crank of the driving shaft *b*, by means of a connecting rod, in the ordinary manner, the batten is attached to a sliding box or block a^1, which works to and fro, in horizontal guides *c*, formed in or connected to the side standards. This sliding box or block a^1, is connected by a rod or link *d*, to a vertical vibrating lever or arm *e*, which works on a pin or stud e^1, fixed upon the floor, or in the framing. The crank or crank pin b^1, of the driving shaft *b*, is made to work in a curved slot *f*, formed in this vibrating lever *e*, and as part of this slot corresponds with the arc described by the crank in its revolution, as shown by dotted lines, it follows that during a portion of the revolution of the crank b^1, the batten *a*, will be allowed to dwell, and will not recede in the usual manner while the shuttle is passing through the shed.

As a modification of the above arrangement, the same object may be effected by means of a pair of cams on the main driving shaft, as shown at fig. 2. A cam b^2, is mounted on the driving shaft *b*, at each end of the loom, instead of cranks, as in the arrangement just described. The ends of the batten *a*, or rather the blocks which carry the batten, are made to work in the horizontal slots or guides *c*, *c*, in the framing, as in the former instance; but it will be evident that the batten may, if preferred, be suspended in the ordinary way. In this modification, the batten *a*, is provided with a pair of arms or rods d^1, at the ends of which are antifriction rollers d^2, against which the cams b^2, on the main driving shaft *b*, bear. The trucks of the batten are kept in contact with the driving cams, either by means of strong springs as shown, which will

draw or force back the batten, after it has beaten up the weft, or by means of a weighted lever. It will be obvious, however, that in place of the springs or weighted lever, to keep the rollers of the batten in contact with the cams b^2, the arrangement with counter cams, shown in fig. 3, may be employed.

The second part of the invention relates to a novel mode of constructing the shuttle plank or batten of looms for weaving narrow fabrics of, say, from two to six or eight inches wide, and consists in the adaptation to the shuttle plank, or to a plate attached thereto, of antifriction rollers, for the purpose of holding up the shuttles in a horizontal position, while they are being driven through the shed. This part of the invention is shown at fig. 4, which is a front elevation of a batten, with the improvements adapted thereto. It will be seen that the upper half of the shuttle plank *g*, is cut away, and in place thereof a metal plate *h*, on which the supporting rollers *i*, *i*, *i*, are mounted, is fixed thereto. One of these plates is shown detached, in elevation, at fig. 5. The shuttles *j*, are moved to and fro by a peg motion in the ordinary manner, and, in so doing, they pass under the rollers *i*, *i*, which will hold them up in a perfectly horizontal position, and will prevent their ends from dipping down, when passing through the shed, as is sometimes the case in looms of the ordinary construction. One of the advantages of this improvement is, that when the shuttle race or shuttles wear away by continual use, the metal plate *h*, which carries the antifriction rollers *i*, *i*, can be lowered in proportion, so as to cause the worn shuttles to fit the race as well as they originally did. In order to admit of this adjustment, the plate *h*, has two slots h^1, *h*, made in it, to receive the tightening screws *k*, *k*, whereby the plate *n*, is attached to the shuttle plank of the batten. By thus being enabled to adjust the rollers *i*, *i*, so as to prevent the ends of the shuttles from dipping, it will be obvious that a shorter shuttle than heretofore can be employed, thus admitting of an additional number of breadths being woven in the loom.

The patentee claims, "First, the combination of parts herein shown and described, or their equivalents, for working the batten, so as to obtain a dwell for the purpose set forth. Secondly,—the mode set forth, or any mere modification thereof, of constructing the shuttle plank."

Scientific Notices.

INSTITUTION OF CIVIL ENGINEERS.

November 14th, 1865.

J. R. McCLEAN, Esq., President, in the Chair.

The first Meeting of the Session 1865-66 was occupied by the reading of a paper on "*The Telegraph to India, and its Extension to Australia and China*," by Sir Charles Tilston Bright, M.P., M. Inst. C.E.

After referring to the previous attempts to establish telegraphic communication with India by the Red Sea, and alluding to the causes

of the failure of that enterprise, the Author proceeded to describe the steps taken by the Government to carry out the line through Mesopotamia, and by the Persian Gulf to Kurrachee, which was now in daily operation, connecting England with Calcutta, Bombay, Madras, and all the principal towns of India, and extending as far to the eastward as Rangoon.

A description was given of the manufacture, laying, and electrical tests applied to the submarine cables between the head of the Persian Gulf, Bushire, Mussendom, Gwadur, and Kurrachee, the engineering and electrical superintendence being carried out for the Indian Government by the Author and his partner, Mr. Latimer Clark, M. Inst. C.E. The cables in question belonged to the class of shallow water cables, the depth being generally about 40 fathoms, and the bottom being principally sand and soft mud—circumstances the most favourable for the deposition of submarine lines. The core was composed of 225 lbs. of copper and 275 lbs. of gutta-percha per nautical mile, the gutta-percha being applied in four separate coatings; over this was laid a bedding of hemp, covered by twelve galvanized iron wires, the whole being coated with two layers of a compound of bitumen and silica, applied in a plastic state, in combination with two alternate servings of hemp laid in opposite directions. In the construction of the conductor four segmental pieces of copper within a copper tube were used, by which the mechanical advantages of a strand were preserved, while the electrical efficiency was added to in consequence of the cylindrical form of the exterior.

The elaborate system of electrical tests taken during the construction and laying of the cable, and a series of experiments determining, for the first time, the differences of conductivity of gutta-percha and india-rubber at various temperatures, were fully described, a formula being given as a guide in calculating the effect of changes of temperature upon the insulation of submarine cables. A new method of testing the joints in the core separately was introduced, whereby a considerable gain in insulation was attained. The conductivity of the whole of the copper wire used was measured, and all wire below an established standard was rejected. By this means a high degree of conductivity was arrived at.

The total length manufactured was 1234 nautical miles, weighing in all 5028 tons. Five sailing vessels and one steamer conveyed this mass of submarine cable to Bombay, and the submersion was commenced by the Author on the 3rd February, 1864, at Gwadur, on the coast of Belochistan, the whole being completed by the middle of May in the same year. The cables were laid for the first time successfully from sailing vessels towed by steamers, by which a considerable saving was effected, compared with the cost of sending the cable round the Cape in steam-vessels.

It was expected that the Turkish land line, between Bagdad and the head of the Gulf, would have been completed simultaneously with the submersion of the Persian Gulf line. In this, however, much disappointment was experienced, owing to the Arabs, on a portion of the route, in the valley of the Euphrates, being in revolt against the Turks. In consequence of this, the opening of the entire line between Europe and India was delayed until the end of February in the present year, when a telegram was received in London from Kurrachee in eight

hours and a half. This was speedily followed by numerous commercial messages to and fro, and a large remunerative traffic was now daily passing. The Author, however, complained of the delays and errors arising upon the Turkish portion of the line, between Constantinople and Belgrade; the service on the portion of the line worked by the Indian Government, between India and the head of the Gulf, being performed rapidly and efficiently.

The difficulties encountered by Major Champain, R.E., in the construction of the Persian telegraph, between Teheran, Ispahan, Shiraz, and Bushire, were described, and the loss of the late Colonel Patrick Stewart, R.E., and his devoted services, were feelingly alluded to.

In considering the extension of telegraphic communication from Rangoon to China and Australia, the Author entered upon a narration of the advantages and otherwise of the several plans proposed; and considered, although part of the line in the Malay Peninsula, and elsewhere, might be taken by land, that the speediest and most reliable means of carrying the object into effect would be found in the submergence of submarine cables, if properly constructed and laid. The regularity of the working of a good system of cables would, in his opinion, soon compensate for the additional outlay involved over such sections of the line. It was thought that a line might be carried, in a comparatively short time, from Rangoon to Singapore, thence to Batavia, joining the Dutch land lines there, and passing from the south-eastern extremity of Java to Timor, onwards to the Australian coast, whither the Australian land lines were rapidly advancing, and would be erected to meet the cable. From Singapore a line could be carried to China, touching at Saigon, or the Peninsula might be crossed at Mergui, and the sea line be carried thence across the Gulf of Siam.

INSTITUTION OF MECHANICAL ENGINEERS.

May 4th, 1865.

F. J. BRAMWELL, Esq., in the Chair.

The paper read was, "*On the application of steam power to cultivation*, by the late Mr. John Fowler, and Mr. David Greig, of Leeds.

In a paper on this subject read by Mr. Fowler at a former meeting of the Institution, on 29th April 1857, reference was made to the draining plough, first drawn by horse-power and afterwards by steam, and to the course of experience that the writer had with that implement, which had led him step by step to the application of steam power to the ordinary purposes of cultivation. In that paper the results of his experience were given for the previous seven years, during which this work had been developed; and in the present paper the subject is proposed to be continued by the results of his subsequent experience in carrying out the application of steam power to cultivation during the last eight years. This paper, which was left unfinished at the time of Mr. Fowler's recent death, has been completed by Mr. David Greig, who had been long associated with him in carrying out steam cultivation.

In considering the mechanical problem to be solved in the application of steam power to agriculture, it is requisite, before referring to the design of any particular machine, to examine the general principles on which the application of mechanical power to cultivation can best be effected. To do this effectually it is necessary to ascertain the nature and extent of the difficulties to be overcome; and these may be stated to be the following:—

I. The irregularities of level in the surface to be acted upon.

II. The varying positions of the machinery upon the ground, rendered necessary as the work proceeds.

III. The difficulty of getting heavy engines of sufficient strength moved about where no roads exist.

IV. The production of a rope of sufficient strength, hardness, and elasticity, to stand the work.

V. The changes in the state of the soil from the effects of weather.

I.—First, with regard to the irregularities of level in the surface of the land to be cultivated.

The first idea which naturally occurs in applying steam power is that of attaching the motive power direct to the implement, as is done in the case of horses. But experience has proved that to move over the land a steam engine of sufficient power and weight for traction purposes is quite impracticable; from the fact that such an engine would weigh at least 12 tons, and would in many cases absorb as much as 30 horse-power in the mere act of moving itself at the rate of two and a half miles per hour. Moreover, when the land gets at all wet and greasy on the top, it becomes quite impossible to make such an engine travel over the soil. Also, the compression caused by its travelling over the land would in most cases neutralise the good otherwise effected by the cultivating implement; so that any advantage which there might be in direct action would be more than counterbalanced by the practical difficulties that stand in the way of its adoption.

Under these circumstances it becomes absolutely necessary to convey the power over the surface of the land by means of a rope, allowing the prime mover to stand in the most direct position for its work, and exert all its force in accomplishing the operation to be performed. The employment of wire rope for this purpose was at first attended with considerable drawbacks, both from the difficulty involved in the application itself, and from the wear of the rope; the latter was chiefly caused by the amount of friction the rope was exposed to, which involved also a loss of power.

The use of wire rope in the cultivation of the soil was gradually developed from its commencement to its present successful application. The first system of using rope was by placing the engine in a stationary position at the side or corner of the field to be cultivated, and leading the rope all round the margin of the field: the two ends of the rope were attached to two winding drums at the engine, giving out and taking in the rope alternately, and the plough or cultivator, being attached to the middle of the rope, was hauled backwards and forwards across the field. This rectangular arrangement involved a great deal of fixing of machinery in the field before commencing operations, including fixing the engine and windlass, fixing a pulley or snatch-

block at each of the two corners of the field nearest to the engine, and a large number of rope porters or carrying pulleys; it also entailed two moveable anchors, one at each end of the line of traverse of the implement, which had to be shifted by some means each time that the traverse was reversed, so as to lead the implement into a fresh line. This complex arrangement of tackle, although it has been extensively used, is now generally superseded by more direct and simple arrangements.

A modification of this mode of using wire rope consisted in placing the stationary engine and windlass in the centre of one side of the field, and leading the ropes away diagonally across the field to two moveable anchors placed at each end of the line of traverse of the implement. A pair of horizontal leading pulleys attached to the windlass allowed the rope to pass off at the varying angles which the progress of the work required, until both the moveable anchors came in a straight line with the windlass. By this triangular plan the two fixed pulleys in the corners of the field were dispensed with, and fully one-fourth of the rope with its requisite porters was saved.

A third plan of working with rope, introduced the direct pull upon the implement, and consisted in placing two horizontal winding drums under a travelling engine, which moved slowly along the headland of the field, keeping always in line with the work. The travelling motion was obtained by means of a pinion gearing into a large internal toothed wheel fixed upon one of the carrying wheels of the engine, and connected to it by a friction clip to prevent any risk of injury from overstrain. The rope was stretched from one winding drum of the engine across the field to a moveable anchor on the opposite headland, and then back to the implement, to which it was attached; and another rope from the other drum was also attached to the implement. The work was performed by the engine winding up one drum as it gave off rope from the other, the implement being thereby pulled backwards and forwards across the field.

The moveable anchor consisted of a carriage with a horizontal pulley mounted below the framing. Round this pulley the hauling rope of the plough passed, while the sharp-edged carrying wheels entered the ground and resisted the side pull of the rope. The anchor carriage was moved forward each time of changing the direction of the implement by means of a stationary rope stretched along the headland and made fast at the end. This rope was attached to a small drum on the anchor carriage, and a slow motion was communicated to the drum from the hauling rope pulley by the intermittent action of gearing. The anchor carriage thus pulled itself along the headland step by step, so as always to keep in line with the implement and engine. The box on the carriage was weighted sufficiently to serve as a counterpoise to the pull.

The experience gained in this plan of working showed that the principle of direct pull of the engine upon the implement was the correct one; but the cumbersome arrangement of the two winding drums, and the difficulty of coiling the whole length of rope required for reaching across the field, together with the crushing of the rope, arising from the soft material of which it was then made, and the small diameter of the drums necessarily employed, indicated the need for a still further modification in the apparatus.

The next step was the employment of an endless rope, stretched across the field as in the preceding case; with this difference, that the power was now communicated to the rope by friction, instead of by winding on and off a drum as in the plan last described.

To secure the requisite amount of hold on the rope, it was found necessary to employ two driving drums with four grooves each, over which the rope was led four times, and the two drums were geared together. In order to meet the variations in the length of the rope occasioned by the irregularities in the boundary of the field, two light barrels, worked by hand, were mounted on the cultivating implement, to which both ends of the rope were attached, and by these barrels a portion of rope was let out or taken up by hand as required to keep it at the proper degree of tightness. When new, this apparatus worked very well; but the wear and tear of the rope from its numerous bends, and more especially from another cause which required some time to develop itself, rendered it necessary to abandon the plan. This great difficulty was the impossibility of keeping the eight grooves in the driving drums all of equal diameter. The two leading grooves were found to be always wearing at double the rate of the others; and all the grooves having to revolve at the same rate, a constant surging of the rope was occasioned by the difference in speed of the circumference of the different grooves. This involved destructive wear of the rope and loss from friction, and every revolution of the drums caused a further grinding away, thus increasing the errors in the diameters of the grooves.

These evils led to the employment of a single driving drum with two V grooves, round which the rope was made to take two three-quarter turns, one in each groove. This was effected by using a guide pulley on each side of the driving drum, which transferred the rope from one groove to the other of the driving drum. The wear and tear was thus greatly diminished; and this apparatus, although retaining to some extent the evils of the former, is still working successfully in several places.

At this point a mechanical contrivance came to the writer's aid, by which a sufficient bite can be obtained with only one half turn of the rope round the driving drum, whilst the rope is taken hold of in such a manner as to cause no friction or surging whatever. At the same time also the total number of bends of the rope is reduced from five to two, as there is only a single bend at each end of the field, which causes a most important saving in driving power and wear and tear. By this mechanical appliance the rope was at once enabled to perform double the amount of work that it could with the previous apparatus.

The contrivance by which this is effected is termed the clip drum. It consists of a series of pairs of jaws or clips, hinged round the circumference of the drum close together in a continuous line, forming a complete groove in which the rope works. Each pair of clips in succession, as it passes round to the point where the pressure of the rope upon the drum commences, closes and seizes hold of the rope, and continues to grip the rope throughout the half revolution until reaching the point where the rope begins to leave the drum, when the clips fall open, being relieved from the pressure of the rope. The amount of grip is in all cases proportionate to the pull upon the rope, and such as effectually to prevent any slipping.

The only provision requisite to suit the clip drum for working with any size of rope is to adjust the width of opening of the clips to the particular diameter of rope to be driven, by widening or contracting the distance between the centres of motion of each row of clips. This adjustment is effected by having the lower row of clips centered upon a ring, which forms the circumference of one-half the depth of the drum; and this ring is screwed upon the body of the drum by a thread chased round its entire circumference, so that by turning the ring round in either direction, the distance between the centres of the upper and lower clips is simultaneously increased or diminished in every pair to exactly the same extent, all of them being kept in perfectly parallel positions.

The lower clip of each pair, having a heavy overhanging lip on the outside, is enabled to lift the upper clip by means of a small finger projecting from its inner end and pressing upon the tail of the upper clip; so that the clips always remain open until receiving the pressure of the rope, and they fall open again, and release the rope, the moment that the pressure is withdrawn. A stop on the upper clip coming in contact with the body of the drum, prevents the clips from falling open too far.

An important practical advantage found to result from the working of this clip drum is, that the rope is subjected to a continual pressure upon its sides whilst passing round the driving drum; thus avoiding all tendency to the rope being flattened by the pull, as in an ordinary round-bottomed groove, where the pressure of the rope is upon the bottom of the groove only.

In the working of this apparatus, the actual result has been, that the portion of the rope which passes round the drum, and has all the work to do of transmitting the hauling power, has lasted longer than the other portion which has no such work to do, but is simply exposed to the bend round the pulley of the moveable anchor on the opposite headland,—the friction from the guide pulleys being exactly the same in both cases. Another important advantage is, that no tension is required upon the rope leaving the drum: all that is requisite is, that the rope be taken away, and not allowed to kink.

II. The second point of difficulty for consideration is the continually varying positions of the machinery upon the ground, rendered necessary as the work proceeds; in consequence of which some means has to be provided whereby the ropes will admit of the two extreme points being moved nearer together or further apart, as the varying boundary of the fields may require. With a pair of winding drums this is easily effected by not allowing the unwinding drum to begin giving off rope until the rope becomes tight in each case. For this purpose a heavy break has to be applied to the paying-out drum to save the rope from trailing on the ground; for if the rope is not kept from touching the ground, a serious loss of power is the result, as the difference in draught required to pull a rope lying on the ground, and one properly carried, is as much as ten to one

The compensating break employed when a pair of winding drums is used, so as to compensate for changes in the length of rope that is required as the work proceeds, may be thus described. The winding drum is driven by a pinion coupled to the driving shaft by a clutch;

but the driving shaft is geared to the paying-out drum, by means of a second shaft having corresponding pinions at each end, so as to allow the two drums to run in opposite directions. The two pinion shafts are however made to revolve at slightly different speeds, by means of two outside pinions of different size, and gearing together, which compel the paying-out drum to revolve 1-9th slower than the winding drum. This causes the slack in the rope to be all taken up by a few revolutions of the drums; and further strain on the rope is prevented by the coupling pinion on the second shaft being connected to its shaft by a friction break. The rope is thus kept constantly stretched tight by the friction of the break.

When the endless rope and clip drum are employed for working the implement, instead of two winding drums, a very ingenious and efficient plan has now been adopted, whereby the rope is kept tight without any loss of power; the slack of the rope is taken up, or more rope is given off, as the field may require, and the implement cannot be started until the rope is tight. This is effected by means of what is termed the slack gear, which consists of two small barrels mounted on the plough, and connected by gearing with a relative speed of five to one, so that the pulling rope in drawing off 1 foot length of rope from the one barrel, winds up 5 feet of the slack rope on the other barrel, until all the slack is taken up. The implement then starts at once when the rope becomes tight, and on its arrival at the other end of the field, the act of the man taking his seat at the other end of the implement, reverses the action of the barrels, so that what was the slack-rope barrel becomes the pulling one, and *vice versâ*. The driving of the barrels is effected by pitch chains. Self-acting levers and clutches, kept in gear by springs, are the means of reversing the motion, they being set in action by the man taking his seat, first at one end and then at the opposite end of the plough. An advantage arising from the use of the slack gear is the elasticity thereby afforded to the rope, should the progress of the implement be obstructed by its coming in contact with stones or roots in the ground; in this case the rope, not being absolutely tight, has a margin for taking up further slack, which acts as a spring, easing the strain caused by stopping the implement suddenly.

III. The third difficulty to be considered is that of getting heavy engines of sufficient strength moved about over the ground where no roads exist.

This has been a serious drawback to the introduction of steam cultivation, and one which has led to more breakage of tackle and machinery than all the action of the machinery in performing its work of cultivation. Two causes have contributed to this result: namely, a mistaken idea at first prevailing, that lightness was an essential point, which led to paring down the metal in all parts of machinery; instead of making the machinery so strong that it could not be broken by the full steam power, and then increasing the width of the carrying wheels to such an extent as to ensure carrying the engine over the wettest fields. The other mistake was, that the speed of working on the road wheel was not reduced sufficiently, so as to allow the engine sufficient leverage to get out of any difficulty that it might happen to get into; and the want of judgment on the part of the men using these machines often led to their being put in places of quite unnecessary difficulty.

The first of these mistakes has now been met by making the ma-

chinery so strong, that the steam, when full on, is the weakest part of the whole machine. This has naturally led to great weight; but that is no real obstacle, provided the carrying power of the wheels is increased in proportion to the increase of the weight to be carried. In fact, the weight is an advantage in steadiness for working, so long as the machine can be kept from sinking too much into the ground. Carrying wheels are now being made for special circumstances as much as 30 inches wide on the rim, and they have been proved to carry a 12-ton engine over any land in a state fit for cultivation. The wheels are driven each separately by means of a friction clip, which prevents any risk of breakage from excessive strain of driving.

The next point was to reduce the speed on the driving wheel so as to give the engine sufficient leverage to get out of any difficulty; and for this purpose two different driving speeds are provided, one giving 2½ miles per hour and the other only 1 mile per hour for travelling, when the engine is working at its full speed of 140 revolutions per minute. In order to obtain sufficient adhesion under specially difficult circumstances for the exertion of the full tractive power of the engine, the additional provision has been made of temporarily fixing transverse T irons, by means of bolts, upon the rims of the wheels. With regard to the men, time and experience, combined with the extra work caused to them by getting into difficulties, are the means of gradually reducing the difficulty arising from want of judgment on their part.

Another plan for meeting the difficulty of getting such heavy machines moved about has been adopted with the most satisfactory results. This consists in combining the power of two small-sized engines; the second engine being worked in place of the moveable anchor. Each engine is provided with a clip drum, which is essential to carrying out this system of cultivation; and the rope is worked as an endless rope between the two engines, by having both its ends attached to the cultivating implement. As the power of both engines is applied at the same time to the rope in each direction, the heaviest class of operations can be performed by them; and the loss of power in working the rope is very much lessened by the fact, that both lines of rope are always in effective tension, and are thereby well carried with half the number of rope porters.

IV. The fourth difficulty to be surmounted was, the production of a rope of sufficient strength and hardness, combined with elasticity, to stand the required work; and this was a very serious point, as the inability to accomplish it nearly upset, at one time, the profitable employment of steam cultivation.

The first rope used was made of iron wire; but it was worn out so quickly, not doing so much as 200 acres, that it soon became evident such material would not stand the strain and friction attending the work; whilst, by increasing the strength of the rope, its weight was so much increased, as to consume nearly the whole engine power in overcoming its friction. These difficulties became so serious, that great exertions were made to get a rope of steel sufficiently hard to stand the wear of trailing on the ground, and also the friction caused by coming in contact with the numerous pulleys of the machinery then employed; and, in 1857, two steel ropes were applied, which answered the purpose admirably, and performed, with the then imperfect machinery, upwards

of three times the amount of work that was done by the first iron rope. From this point, it was established undoubtedly that all risk of the difficulty with the rope causing a check to the application of steam to cultivation was now safely overcome; the introduction of the steel rope having effectually accomplished the object in view. The machinery for working the rope, however, required great improvement and alteration, before getting to the point of thorough efficiency with a minimum of wear: the chief objects in these improvements being, to have as few bends as possible, and those bends over large pulleys. A great saving in the wear of rope has also been effected by the improved means of keeping the rope tight, and preventing it from dragging on the ground. From time to time, as the various improvements in the machinery have been effected, the increased quantity of work done by the rope before being worn out has been very marked; so that the cultivation of from 2000 to 4000 acres can now be accomplished with one steel rope, the amount varying with the nature of the soil and the width of the implement used.

At the commencement of steam cultivation, the iron wire rope ran a mileage of not over 750 miles before being worn out, costing 1*s.* 7*d.* per mile of running. The first steel rope ran 1800 miles, costing 1*s.* per mile; and the present steel ropes are running on an average 9000 miles, costing only about 2¼*d.* per mile, running with a tension upon them of about 25 cwts., and this, notwithstanding that the price of rope has been increased from £60 to £84 for the ordinary length of rope of 800 yards. The steel rope at present used in steam cultivation is 11-16ths inch in diameter, and weighs about 2lbs per yard, making a total of about 14 cwts. for the length of 800 yards.

V. The fifth class of difficulties are those arising from variations in the state of the soil, caused by the effects of the weather.

These difficulties have been principally felt in wet weather, in moving the engine, and also from the stickiness of some land when in a half wet state, which is too often the condition of the land whilst being cultivated. In such cases, all the tackle would become literally covered with clay, and the power required to move the rope and the machine would be very great. This difficulty should not, indeed, exist, as no land ought to be touched when in such a state; but clay land has hitherto very often been worked when wet, from want of sufficient force to get all the work done before the wet sets in, and also from the inability of horses to perform the work while the land is in a dry state. As an illustration, may be taken a clay land field, ploughed by horses while very wet; after which, if the next year be dry, it will be literally impossible to work the same ground with horses until some rain comes to soften it, as the horses' shoulders and the implement would not be able to stand such jarring work.

With steam power, however, there is no difficulty in working the land in the driest condition, which is the proper time for such work; and if this is strictly attended to, it will never get into an extremely hard state. Supposing the clay land is ploughed wet by steam power, more power will be expended in pulling the dirty rope and the sinking plough than even if the land be so dry that the soil breaks up into large pieces of as much as 1 cwt. each, though the latter could not be the case, but for the wet-kneading that the land received before by

being ploughed wet by horses. If the farmer were only to keep his machine off the land in wet weather, and work it night and day in dry weather, he would see the great advantage that would accrue from working at the proper time. In fact, the principle of the old maxim, "make hay while the sun shines," applies to cultivation of the land as well as to hay.

Another system of steam cultivation has been adopted to meet special circumstances, by the use of two large engines, each of which is supplied with a winding drum, instead of the clip drum and endless rope employed with the light engines, in the plan last described. The two large engines are placed at opposite ends of the field, but they act alternately instead of in combination—one pulling the plough in one direction, while the other moves forward into position for the return bout, and *vice versâ*.

In order to make the rope coil in a regular manner upon the winding drums of the engines, an arrangement of self-acting coiling gear is employed, consisting of a pair of traversing guide rollers between which the rope passes when coiling on or off the large winding drum. The purpose for which this system of working with two large engines was arranged was for travelling about and doing work by hire, so as to meet the requirements of those who have not sufficient land or capital to purchase machinery for their own use. So far as the working of these machines goes, it is entirely satisfactory, but the first drawback to the adoption of this plan is the price. Secondly, there is the difficulty of taking two large engines about; and from the fact that a heavy break has to be put on the paying-out drum in order to keep the rope tight, considerable power is lost. But still the time saved in doing small irregular fields more than counterbalances those disadvantages.

The traction part of the machinery having now been considered, the most mechanical means of performing steam cultivation has to be referred to.

The implements hitherto used for steam cultivation have been something similar to those employed with horse power; but recently a system has been arranged for throwing up the land in the roughest possible way, and leaving it in such a state as to expose the largest amount of surface to be acted on by the air, which is the only truly practical way of dealing with heavy land.

Cultivation by rotary implements has been much advocated, and may appear at the first glance the right means of applying steam power: but when the nature of the substance to be dealt with is considered, this plan is mechanically wrong in the way of operating on the soil, from the fact that rotary implements must necessarily strike on the top of the hard land, thus absorbing a quantity of power in entering the hard substance.

The cultivation of the land consists merely in loosening a certain quantity of soil, and what has to be considered is, how to loosen the greatest quantity with the smallest amount of power. In all the experiments tried by the writer, it has been found that this is never so economically done as by wedging the soil off to a loose side, and entering the wedge underneath, where the soil is softer. Much objection has been raised to the old mode of working with the plough; but in

the writer's opinion it is not the implement that is at fault in that case, but the power that is defective; and by the aid of steam that implement can now be driven at such a pace as to throw the land sideways in a manner quite equal to the effect of any digging by hand. The great point requiring attention is that the tools should be so arranged that each follows its neighbour, taking its own cut and wedging off the soil to a loose side. If this is done, the speed of two and a half miles per hour at which the implement is driven will throw the loosened material at least two feet clear from its previous position, and by the rapid motion it will be left in the state most desirable to the farmer and in the best possible condition to receive the action of the atmosphere, and this will be effected with the least amount of power.

In order that steam cultivation may be brought to the greatest perfection, it is of the utmost importance that the use of horses in cultivation should be altogether abandoned. For this purpose a number of implements are required, adapted to get over a large breadth of land in a day, so as to do the very light operations of the farm and exclude horses entirely from such work; as their use inevitably increases the expense of after operations, besides being detrimental to the land. If the horses on a farm are done away with altogether, or as far as practicable, the cartage becomes the next question to be dealt with; and before steam cultivation takes its proper place, the heavy part of the cartage must be done by the ploughing engines. Considering, however, that to be good ploughing engines they must be good traction engines, there is nothing to stand in the way of cartage by steam power but the want of good roads about the farm, which are an essential point in a highly cultivated farm, whether steam cultivation be employed or not. The experience lately gained in the use of the traction engine is that loads can be conveyed over moderately good roads at an expense of 2d. per ton per mile; and there is therefore no doubt that the farm cartage can also be done economically. The writer has no doubt that before ten years' time two-thirds of the cartage of the farm will be generally done by steam, and also that the railways will be fed by traction engines, and that these will become quite common: although, through mistaken ideas, serious attempts have been made to stop their use on the public roads. A 10-horse engine will convey a load of twenty tons independent of itself over a road with gradients not exceeding 1 in 15: and the wear and tear is very slight indeed in properly constructed traction engines.

The advantages of steam cultivation will be understood by the following summary, which contrasts steam power and horse power as applied to cultivation:—

With horses there is a total force of 6 cwts., with the drawback of having to convey 4 tons of useless load over the land; while with steam power there is a total force of 35 cwts. conveying only 1¼ tons of useless load. The result of experience is the less weight carried over the land the better; and when the great weight of horses compared with the force they exert is considered, and also the number of footprints left by them on an acre, it cannot but excite surprise that such an unmechanical means of cultivation should have existed so long. The number of footprints left by four horses in ploughing a 12-inch furrow is above 300,000 per acre; whereas the

steam plough, which has a width of from 3 to 4 feet, is carried on two wheels 6 inches in width.

A few remarks only need be added upon the ultimate effect which will result from the proper adoption of steam cultivation. By thoroughly carrying out the system, definite calculation can be made as regards the cost of working a farm, and better crops will be obtained with a greatly increased amount of certainty. Time, the great point in all business, but more especially in agriculture, will be economised; and from the increased force at the farmer's disposal he will seldom get behindhand with his labour, an evil which at present often causes him to lose a crop altogether in some of his fields. The drainage will be much more efficient, and consequently the temperature of the land will always be kept at the highest point: the result will be that the land will always be in a growing state. Clay land, which is by far the most fit for crops, will be brought to bear the heaviest crops; and this quality of land, which at present pays very little rent, will become the most valuable. Farming will become a business into which a business man may enter with safety, and capital will find in farming a profitable and safe investment, so that increased advantages will accrue to the country. The intelligence of the agricultural labourer will be improved, in consequence of his having to use his mind more and his body less; and this anticipation has received practical confirmation in not a few cases already.

LONDON ASSOCIATION OF FOREMEN ENGINEERS.

Nov. 4th, 1865.

MR. DAVID WALKER IN THE CHAIR.

The paper read was, "*On Foremen Engineers and their Associations,*" by Mr. JOSEPH NEWTON, President.

THE author commenced his paper by noticing the important part which mechanics had played in the development of practical science, referring for illustration to those who had "created for themselves niches in the gallery of fame." With respect to the foremen engineers, he showed that they have to think as well as to act, and that it is in the workshop that the would-be foreman must acquire and exhibit the talent which is to warrant and justify his promotion. *That* is the university in which *he* must graduate, and in which he must earn his degrees. In the workshop he must obtain his honours, and there he must develop his latent powers. No *examining* process will enable him to avoid the *plucking* which sometimes befalls candidates for the Civil Service, or sustain him under the pressure of constantly changing duty. It is only by the plodding and persistent pursuit of information, and the determination to surmount difficulties, that he may hope to rise, or to sustain himself when he has risen, from the ranks of his fellow-workmen.

After referring to the misapprehension entertained by the master engineers of the objects of the Association, the author said the Association stands now before the general engineering community in its true

light, and, he believes, is estimated at something like its real value. It is understood to mean a community of men of similar occupations, similar habits, and similar ideas, associated together in friendly union, for mutual improvement and material good, and that is precisely what it is.

It has been said, that the foreman engineer graduates in the workshop—our meetings enable him to continue his studies, and to keep pace with the rapid mechanical and scientific advancement of the time. True, the Association has not attained to the dignified position occupied by the Institution of Civil Engineers, or to that occupied by the Mechanical Engineers, but it is following worthily in their wake, and may attain to something like their eminence and usefulness.

After sketching the rise of the Civil Engineers' Society from its small beginnings, and comparing it with the progress of the Association, the author said that, from the flourishing condition of the elder institution, the members might take heart in their labours for the prosperity of their own. "Few," he continued, "can estimate more exactly than the writer of this paper the anxious and responsible duties of a foreman engineer. I know that, very frequently, the cares of a harassing day are followed by the horrors of a sleepless night, during which the troubles of the morrow disturb the foreman's brain. I know that he has to rise early, and leave his factory late, and that his intermediate occupations are often multifarious and difficult. All this I know, and much more, of the foreman's ordinary life. Still, it is my conviction that all may do something more towards forwarding the interests of their own Association, and in doing so promote their own. It is astonishing what may be done by *application*, *perseverance*, and *determination;* and it would be possible to cite innumerable instances, in our own profession, in which the possession of those qualities have raised their owners to dignity, to honour, and to wealth. The biographies of scientific men teem with illustrations of the wondrous effects of the talismanic words just mentioned, and show how those who have sought to rise

Out of the prisons of their mean estate;
And with such jewels as the exploring mind
Brings from the caves of knowledge, to buy their ransom,
From those twin gaolers of the daring heart,
Low birth and iron fortune,

have succeeded in effecting their release, and in rising to liberty and greatness. It is not given to every man to be great; but there are few who may not be useful to their fellow-men, if they but seek the means.

"It is my candid opinion, then, that each of the members of this Association should determine to read a paper, and do it. Each has had his workshop schooling; and there is no reason why (in workshop language, if he will) he should not impart some of the knowledge he has gained to his neighbours. There is not one who now listens who has not gained *some* special information—who has not his mechanical pet, who cannot bring forth from the recesses of his mind some favourite theory, or who is not able to deliver himself of an inventive thought. We have had industrial exhibitions, in which the products

—valuable, curious, or grotesque—of the leisure hours of the working men have figured *ad libitum*. My desire is, that here we should have constant exemplifications of the cogitations of our members in *their* leisure hours, details of experience in their busy ones, or speculations on future mechanical improvements. There is around me a mine of intellectual and mental wealth: it only needs *working;* the ore will then soon appear, and the conversion of it to useful purpose will speedily follow. The press will not only stamp that ore with approbation, but give it speedy currency and pass it along the channels of general circulation. It has often been said that we have very few papers read, and that we therefore scarcely deserve the appellation of a scientific society. Let us endeavour to remove the stigma. It is in the power of each of us to assist in the task, and the *will* alone is wanting. Let the coming year display greater activity on our part than that which is passing away, and beyond doubt the influence and dignity of the Institution will be much enhanced by the process.

"From close and constant observation of the feelings, with some knowledge of the habits, and with great confidence in the practical knowledge of the members of this Association, I feel assured that short suggestive papers, provocative of discussion, are the most desirable; and these, fortunately, are within the reach of all. You have little time to spare, no doubt, but such as you have could not certainly be more profitably employed. Bring out, then, your *hobbies*, and let us examine their claims to that distinction. I say this in all earnestness, because the future well-being of the Society depends largely upon self-help. It is impossible to command respect, if no effort be made to attain it. If the Association is to stand independent and erect among its fellows, it must be by the exertion of its own innate strength, and not by mere resting and being thankful for what has been done.

"It has already been observed that we desire the friendship of employers, and I can imagine a period yet to come when those gentlemen will attend in this our lecture-room and studio, not for the purpose of teaching us how to govern the institution, but for that of imparting to us information which their superior position and more fortunate circumstances have enabled them to obtain. I can imagine a time yet to come when, in this arena of friendly discussion, wherein it is desired that all opinions on legitimate subjects may be freely and unreservedly expressed, the employers of engineering labour will take part in our deliberations; and thus, while communicating knowledge, themselves derive, both directly and indirectly, advantage. When that happy period shall have arrived, it is my opinion that this Association will have attained to something like the amount of usefulness of which it is capable. We shall then have employers inducing, not only their foremen, but their *managers*—the latter, a class whom it would be well if we saw more of at our meeting—to assemble at our counsel table, and thus to add to the prosperity of the Association."

Provisional Protection Granted.

1865.

[*Cases in which a Full Specification has been deposited.*]

2729. Louis Dominique Girard, of Paris, obtaining sliding surfaces by the interposition and circulation of a liquid or gaseous fluid between the frictional surfaces.—*October* 21*st.*

2828. Bienaimé Felix Brunet, of Paris, impd. apparatus for ascertaining the degree of torsion and resistance in the threads of textile substances.—*November 2nd.*

2872. Gustavus Adolphus Jasper, of Middlesex, Massachusetts, U.S.A., an invention having reference to the cleansing or bleaching of sugar; which invention may also be applicable to other purposes of like character.—*November 7th.*

Cases in which a Provisional Specification has been deposited.

1666. William Edward Gedge, of Wellington-street, Strand, impd. fire-escape; applicable also to raising loads from mines and other purposes,—a communication.—*June* 21*st.*

1766. John Dale and Richard Samuel Dale, of Manchester, impts. in the production of pigments suitable for printing upon paper and woven fabrics.—*July 4th.*

1774. William Saunders Parfitt, of Devizes, impd. machine for the manufacture of aërated waters.—*July 5th.*

1862. Anson Henry Platt, of Philadelphia, impts. in lamps.—*July* 15*th.*

1898. John Harkness Wray, of Manchester, impd. apparatus for producing sound for signals, calls, and alarms adapted to use on vessels, railway trains, buoys, reefs, lighthouses, and in other places of danger, — a communication. — *July 20th.*

1908. James Warren Roberton, of Edinburgh, impts. in the construction of needle cartridges.—*July 21st.*

2020. Adderley Sleigh, of Upper Belgrave-place, impts. in the means of, and mechanism for, obtaining motive power.—*August 4th.*

2066. William Aston, of Birmingham, impts. in the manufacture of linen buttons.—*August 9th.*

2133. Phineas Lawrence, of Basinghall-street, London, impts. in boots and other coverings for the feet; which impts. are applicable also to trunks and other articles for the purpose of strengthening, preserving, or protecting them,—a communication.—*August* 18*th.*

2188. Edward Henry Woodward, of New York, impts. in saws for sawing and cutting marble and other analogous substances.—*August 25th.*

2200. George Tomlinson Bousfield, of Loughborough-park, impts. in folding chairs, — a communication.— *August 26th.*

2228. James Fallows, of Philadelphia, impts. in sheet metal handles for spoons, saucepans, and other utensils for culinary purposes.—*August 30th.*

2260. John Lake, of Devonport, impts. in tubular steam boilers or generators for agricultural or other locomotive steam engines.—*September* 1*st.*

2292. Augustus William Parker, of Bow, impts. in ice houses and in glaciaria or skating-places and in baths.—*September 6th.*

2293. Frederick Tolhausen, of Paris, a fire-work producing instantaneously the forms of serpents, and other forms of a like nature,—a communication.—*September 7th.*

2322. William Hewitt, of Pimlico, impd. composition for preventing incrustation in steam boilers.—*September* 11*th.*

2336. Thomas Drew Stetson, of New York, U.S.A., impts. in clothes-wringing machines, the mode of communicating rotary motion in which is also applicable to other

machines having similarly rotating parts,—partly a communication.—*September 12th.*

2348. Samuel Fox, of Deepcar, near Sheffield, impts. in the manufacture of umbrellas and parasols, and in apparatus employed therein.—*September 13th.*

2368. Jehiel Keeler Hoyt, of Cheapside, impts. in bobbins, or spools used in spinning and winding yarns and threads,—a communication.

2372. William Esson, of Cheltenham, impts. in the construction of gas meters.

2373. François Carlier, of Paris, impts. in the arrangement and fittings of certain apparatuses for extinguishing fires.

The above bear date September 16th.

2382. Charles Worssam, of Commercial-wharf, Kingsland-road, impts. in the means of, and apparatus for, consuming smoke in furnaces.—*September 19th.*

2395. Joseph Edmondson, of Halifax, impts. in looms for weaving.—*September 20th.*

2404. Sanders Trotman, of Lyme-street, Camden-town, impts. in the manufacture of paper.

2412. Henry Albert Davis, of Camberwell, impts. in apparatus for affixing postage stamps and other labels to letters and documents.

The above bear date September 21st.

2418 Robert Atkin, of Crawford-street, Bryanston-square, impts. in propelling vessels.

2425. George Binnie Mc Nicol, of Glasgow, impts. in apparatus for obtaining motive power.

The above bear date September 22nd.

2437. Joseph Donnell, of Liverpool, impts. in machinery for cutting or mincing meat and stuffing the same into skins or intestines for forming sausages,—a communication.—*September 23rd.*

2448. William Unwin, of Sheffield, impts. in the manufacture of iron.

2453. William Edward Newton, of Chancery-lane, impd. construction of engine, which can be used either as a motor or for pumping,—a communication.

The above bear date September 25th.

2456. Nicholas Korshunoff, of Birmingham, impts. in the manufacture of cast iron, malleable iron, and steel.

2458. John Sampson Starnes, of Cockhill, Ratcliffe, impts. in the manufacture of submarine lamps.

2464. Richard Archibald Brooman, of Fleet-street, impts. in moulding crucibles and other hollow articles of plastic materials, and in apparatus employed therein,—a communication.

2465. Alfred Vincent Newton, of Chancery-lane, impd. mode of decarbonizing retorts,—a communication.

The above bear date September 26th.

2470. Archer Farr, of Dunstable, impd. receptable for tooth powder, and for conveying the same from such receptable to the toothbrush, so as to economise the use of the powder, and to prevent the escape of the perfume with which it may be scented.—*September 27th.*

2484. Cyrus Price, of Wolverhampton, impts. in locks and latches.

2486. Maurice Nopitsch, of Paris, impts. in pencils and pencilcases having a moveable lead.

2490. Alfred Mosley Bennett, of Oakfield Gateacre, near Liverpool, impts. in apparatus for ascertaining specific gravities and the bulk of solids, and also for other similar uses.

2492. Charles Edmund Davis, of Bath, impts. in cisterns or chambers for the steeping of grain in the manufacture of malt; which improvements are also applicable to other chambers or enclosures.

2494. Isaac Smith and William Fothergill Batho, of Birmingham, impts. in apparatus for heating, evaporating, and cooling liquids.

2496. William Edward Newton, of Chancery-lane, impts. in shoeing horses,—a communication.

2498. Richard Archibald Brooman, of Fleet-street, impts. in sewing machines,—a communication.

The above bear date September 28th.

2500. Johann Heinrich Pinckvoss, of Mark-lane, impts. in the construction of casks to be used more especially for the transport of oil.

2502. William Edward Gedge, of Wellington-street, impts. in steam engines,—a communication.
2504. George Davies, of Serle-street, impd. reclining chair,—a communication.
2506. John de Weweirne and Alexandre Verschaffelt, of Ghent, impts. in dyeing.

The above bear date September 29th.

2510. John Witherden Hurst, of Deptford, impts. in life rafts.
2511. Joseph Edward Townshend, of Curtain-road, Shoreditch, impd. ventilating spring mattress.
2512. Edward Linder, of Old Broad-street, impts. in breech-loading guns and in projectiles and cartridges.
2514. Robert Willacy, of Penwortham Priory, Lancashire, impts. in machinery or apparatus for preparing and supplying food for cattle.
2516. John William Moore Miller, of Southsea, impd. process for preparing skins and hides or leather so as to render such substances waterproof and more durable than heretofore.
2518. Samuel Faulkner, of Blackley, impts. in apparatus for grinding cards for carding engines.

The above bear date September 30th.

2522. James William Tyler, of Abingdon-street, Westminster, impts. in the means employed for fixing sheet metal for roofing and other purposes.
2524. David Greig and Robert Burton, of Leeds, impts. in travelling cranes.
2526. Henry Gilbert James, of Bristol, impts. in railway signals.
2528. Silas Covell Salisbury, of New York, impts. in blast furnaces.

The above bear date October 2nd.

2530. Henri Adrien Bonneville, of Paris, impts. in the construction of submarine telegraph cables,—a communication.
2532. William Robert Lake, of Southampton-buildings, impd. sewing machine,—a communication.
2534. Charles James Tinker, of Pontefract, Yorkshire, impts. in the manufacture of lozenges, cakes, and other similar articles from plastic substances.
2536. Richard Archibald Brooman, of Fleet-street, impts. in preparing red and violet coloring matters for dyeing and printing silk, wool, cotton, and other textile vegetable and mineral substances,—a communication.
2537. William Edward Newton, of Chancery-lane, impts. in pneumatic ways for the transmission of letters, merchandize, and passengers, — a communication.
2538. William Edward Newton, of Chancery-lane, impt. in machinery for spinning, twisting, doubling, and winding yarns, or threads,—a communication.
2540. Enoch Farr and William Tarr, both of Chorlton-upon-Medlock, Manchester, and Isaac Gregory, F.R.G.S., of Manchester, impts. in pianofortes.

The above bear date October 3rd.

2541. Frederick Tolhausen, of Paris, impts. in musical reed instruments of the harmonium class, said impts. also forming in combination a small instrument of a novel construction, —a communication.
2542. Joseph Jones and Frederick James, of Birmingham, impts. in cartridges for breech-loading fire-arms.
2544. Allan Craig, of Mold, Flintshire, impts. in apparatus for extracting oil from coal shale and other minerals.
2546. Edwin William De Rusett, of Lewisham, and Richard Farrell Dale, of Shoe-lane, impts. in ships' water closets.
2548. John Dodge, of Manchester, impts. in file-cutting machines.
2549. James Webster, of Birmingham, impts. in gas meters.

The above bear date October 4th.

2552. Hesketh Hughes, of Homerton, impts. in machinery for shaping metal and other substances.
2554. John Charles Stovin, of Whitehead's-grove, Chelsea, impts. in cleaning cotton seed,—a communication.
2556. Edward Marsland and Peter Williams, of Manchester, impts. in instruments for punching or perforating leather and other materials.
2558. Robert Morson, of Queen-

square, Bloomsbury, impts. in treating meat, and in obtaining products therefrom.

2560. Hector Auguste Dufrené, of Paris, apparatus for raising weights by means of the feet or hands,—a communication.

2562. Benjamin Johnson, of Church-street, Camberwell-green, impts. in pianofortes.

2563. Robert William Fraser, of Edinburgh, impts. in the propelling and steering of steam ships or other vessels, and in the machinery or apparatus employed therefor.

The above bear date October 5th.

2564. John Holliday, of Huddersfield, impts. in preparing violet, blue, and red colouring matters.

2565. Louis Rollier Whitehead, of Birmingham, impd. date and other indicator, together with an impd. method of arranging the date papers thereon.

2566. Charles Fitz Gerald, of the Langham Hotel, London, impts. in fasteners for doors.

2568. Henry Francis Smith, of Manchester, impd. composition or material to be employed in waterproofing or rendering woven fabrics impervious to moisture.

2570. Frederick William Gardiner, of Leicester, impts. in apparatus for laying telegraphic cables in deep waters.

2572. Louis Alexandre Isidore Daumesnil, of Paris, mechanical propelling screw toy.

2575. William Arena Martin, of Cannon-street, impts. in apparatus for signalling by means of combined whistles.

2576. William Dakin Grimshaw, of Birmingham, impts. in capstans.

2578. John Cunningham, of Liverpool, impts. in the construction of fireproof floors for buildings.

2579. Chauncey Orrin Crosby, of New Haven, impts. in ruffles or frills composed of strips of fabrics, and in the machinery or apparatus employed for their manufacture.

The above bear date October 6th.

2582. James Roddy, of Liverpool, impd. washing or cleansing liquor or solution.

2583. James Priestly, William Whitworth, and John Sutcliffe, of Sowerby-bridge, near Halifax, impts. in apparatus for grinding corn, seeds, and minerals.

2584. Charles Hanson Mellor, of Oldham, impts. in telegraphic communication for the purpose of indicating danger.

2586. John Hancock, of Nottingham, impts. in signals for railway trains.

2588. Joseph Kirby, of Preston, impts. in "pirn" winding machines for winding flax, cotton, and other fibrous matecterials.

2589. Thomas Matthew Gisborne, of Lymington, impts. in the means employed for cleansing the bottoms of ships or vessels.

2590. Tomlin Campbell, of Jamaica, impts. in evaporating and distilling liquids, and in the apparatus employed therein.

2591. William Harris, of Wimbledon, impts. in tanning or treating hides, applicable for machine bands and other purposes.

2592. Jacob Baynes Thompson, of Rothwell-street, Regent's Park-road, impts. in coating iron and steel with gold, silver, platinum, or copper.

2594. Julius Homan, of the Grove, Camberwell, impts. in constructing fire-proof floors and ceilings.

The above bear date October 7th.

2596. Peter Todd and Joseph Holding, of Wheelton, near Chorley, impts. in looms for weaving.

2598. John Robertson, of Langham-chambers, Portland-place, impd. colour slide and case for the use of artists and painters.

2600. William Edward Gedge, of Wellington-street, Strand, impd. machinery or apparatus for obtaining motive power by expansion of air,—a communication.

The above bear date October 9th.

2602. William Cooke, of Park-house, St. James's, impts. in apparatus for the regulation of the up and down currents of air, and for the prevention and cure of smoky chimneys.

2603. William Cooke, of Park House, St. James's, impts. in window fittings.

2604. John Sturgeon, of Burley, near

Leeds, impd. mode of generating steam.

2605. François Thierry Hubert, of Deptford, impts. in submarine electric telegraph cables, and in apparatus connected therewith.

2608. William Edward Gedge, of Wellington-street, impts. in the construction of billiard tables and impd. apparatus for ascertaining the degree of elasticity of the cushions and the strength of the cloth,—a communication.

2610. John Henry Johnson, of Lincoln's-inn-fields, impts. in the construction of steam generators, applicable also to the construction of condensers, the heating of water generally, and to the warming of buildings,—a communication.

2611. Mark Walker, of Mansfield, Nottinghamshire, impts. in flyers used in doubling machines.

2612. John Fletcher Wiles, of Upper Clapton, impts. in submarine telegraphy.

2613. Arthur Nicholls, of Barnsbury-row, Islington, impts. in rules for measuring, and in other instruments or articles requiring to be adjusted or disposed at various angles.

2614. Richard Abell, of Cambridge-terrace, Pimlico, impts. in trapping and ventilating sewers.

2615. John Joseph Parkes, of London-street, Paddington, impts. in the manufacture of railway station and other gas lamps.

2616. Daniel Gallafent, of Stepney, impts. in paraffin lamps.

The above bear date October 10th.

2617. Thomas Warburton, of Stoneclough, Lancashire, impts. in breaks for carts, waggons, and other vehicles.

2618. Frederic Pelham Warren, of Cosham, impts. in bolts, rivets, and the like fastenings for connecting together pieces of metal and other material.

2619. James Crutchett, of Stroud, impts. in the manufacture of bands, belts, or straps for harness, for driving machinery, or for other purposes.

2620. James Crutchett, of Stroud, impts. in the manufacture of gas.

2621. Michael Henry, of Fleet-street, impts. in railway carriages and locomotives,—a communication.

2622. William Edward Gedge, of Southampton-buildings, impts. in double or single action pumps,—a communication.

2623. Thomas Du Boulay, of Sandgate, impts. in carriages propelled by manual power.

2624. Denison Chauncey Pierce, of America-square, impts. in the permanent way of railways.

The above bear date October 11th.

2628. Jasper Henry Selwyn, of Grassmere, Westmoreland, impts. in cartridges for certain kinds of breech-loading fire-arms.

2629. Robert Longdon, of Ashbourne, Derbyshire, impts. in hurdles for fencing or dividing grass and other lands, and for other like purposes.

2631. James Broughton Edge and Enoch Hird, of Bolton, impts. in machinery or apparatus for twisting or doubling cotton or other yarns.

The above bear date October 12th.

New Patents Sealed.

1865.

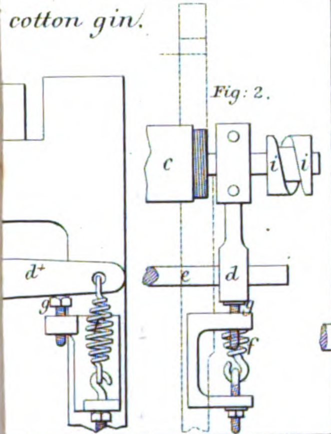
1168. F. D. P. J. Cabasson.
1174. W. H. Smith.
1178. H. W. Wood.
1179. Samuel Harvey.
1181. J. F. Feltham.
1182. R. A. Brooman.
1184. A. Grainger and C. M. Girdler.
1188. Edward Moore.
1190. Edward McNally.
1191. Julian Bernard.
1193. R. Ferrie, J. Murray, & A. Wilson.
1195. A. Wyllie and J. M. Gray.
1197. L. W. Broadwell.
1198. Thomas White.
1200. G. P. Dodge.
1201. William Clark.
1202. P. A. le Comte de Fontainemoreau.
1203. William Leatham.

1206. D. Y. Stewart.
1208. Henry Bessemer.
1210. C. E. Herpst.
1213. J. C. Davis.
1215. M. W. Ruthven.
1216. W. E. Wiley.
1224. Rest Fenner.
1227. Francis Wise.
1229. Thomas Allcock.
1230. C. W. Siemens.
1231. Jules Catillon.
1232. J. B. Lavanchy.
1234. E. T. Read and J. B. Fyfe.
1238. T. W. Roe.
1239. William Clark.
1243. Gustave Josse.
1244. E. G. Smith
1245. W. F. Stanley.
1247. George Redrup.
1248. Frederick Caldwell.
1249. Josiah Hampton.
1250. William Roberts.
1251. John Lilley.
1252. A. Mackie, H. Garside, and J. Salmon.
1254. George Peel, jun.
1255. William Henderson.
1257. T. J. Mayall.
1260. Joseph Mitchell.
1261. J. Wadsworth, H. Dusset, and J. McMurdo.
1262. James McGlashan.
1270. James Buchanan.
1273. John Casey.
1274. J. H. Johnson.
1275. R. B. Cooley.
1277. Patrick Welch.
1278. J. C. C. Halkett.
1283. T. J. Mayall.
1284. George Hartley.
1287. William Jackson.
1288. C. S. Baker.
1290. S. L. Fuller, A. Fuller, and C. Martin.
1291. Daniel Adamson.
1294. H. W. Hart.
1297. John Forbes.
1298. James Melvin.
1299. P. Brush and R. Irvine.
1300. J. J. Révy.
1303. S. Pokutynski and M. Mycielski.
1304. James Goodwin.
1305. J. H. Johnson.
1307. William Jamieson.
1309. T. J. Mayall.
1311. G. Mountford and E. Worrall.
1312. D. Ellis and M. Hillas.
1313. Alexander Parkes.
1314. E. L. Girard.
1315. Emile Cordonnier.
1316. T. Smith and H. James.
1317. James Hesford.
1321. Richard Winder.
1322. W. Chubb and S. Fry.
1326. John Eddy.
1327. Thomas Davis.
1328. Thomas Craig.
1329. T. Parkinson and W. Snodgrass.
1333. H. J. Burt.
1335. William Clark.
1340. George Ennis.
1341. W. Deakin and J. B. Johnson.
1342. C. J. Appleby.
1343. G. Elliott and S. B. Coxon.
1344. R. and H. Harrild.
1345. Henry Besley.
1346. John Dauglish.
1348. H. A. Bonneville.
1349. H. A. Bonneville.
1355. P. C. Lafont.
1357. Richard Leddicoat.
1361. George Walton.
1362. André Chavanne.
1363. C. O. Crosby.
1370. W. R. Williams.
1381. G. H. Brooks.
1383. Thomas Marsden.
1386. William Davey.
1390. C. Varley and S. A. Varley.
1403. A. G. Bigoric.
1417. T. Calvert and D. Montgomery.
1421. H. A. Bonneville.
1434. J. H. Johnson.
1440. H. E. Newton.
1465. Henry Tipper.
1466. William Little.
1507. William Clark.
1514. W. E. Newton.
1517. Thomas Pritchard.
1544. James Kennedy.
1553. James Haworth.
1698. T. L. Jowett.
1718. J. K. Farnworth.
2044. W. Pollock and J. Stobo.
2285. James Pilkington.
2289. Thomas Nicholson.
2337. W. J. Murphy.

*** *For the full titles of these Patents, the reader is referred to the corresponding numbers in the List of Grants of Provisional Specifications.*

cotton gin.

Fig: 2.



Harding's ordnance.

Fig: 3.

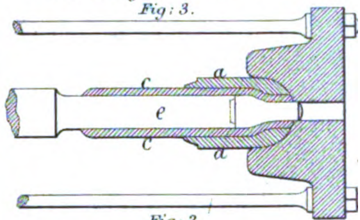
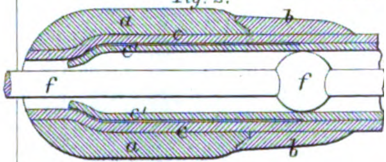


Fig: 2.



...e's gin rollers.

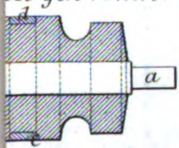
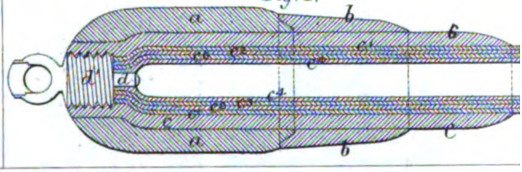
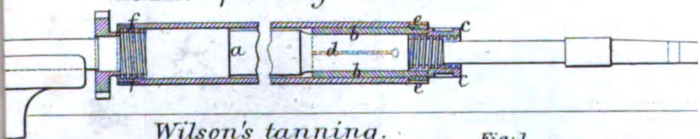


Fig: 1.



Mather's printing rollers.



Wilson's tanning.

Fig: 2.

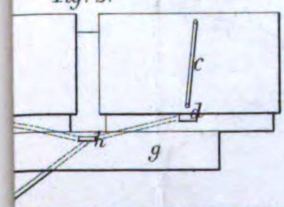


Fig: 1.

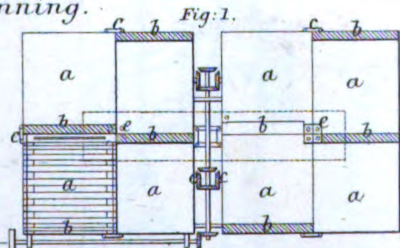
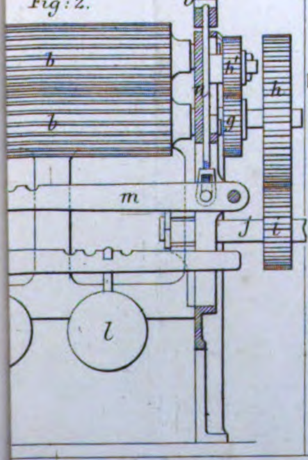


Fig: 2.



Topp & Holt's spinning.

Fig: 2.

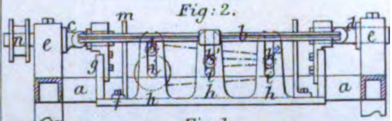
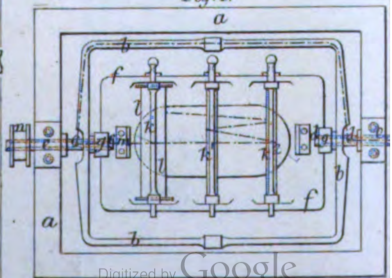
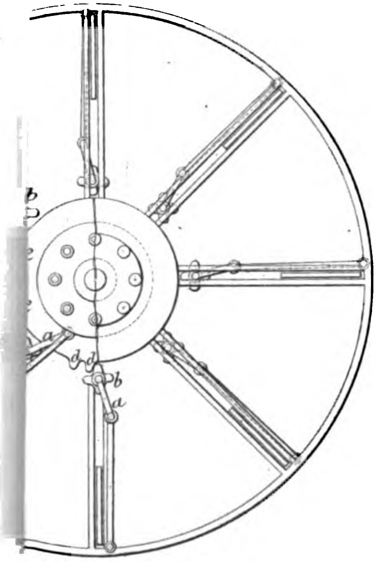
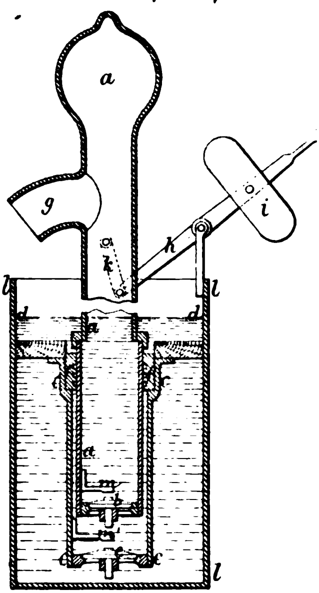


Fig: 1.



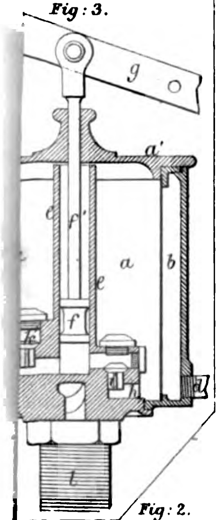


Beattie's pumps.

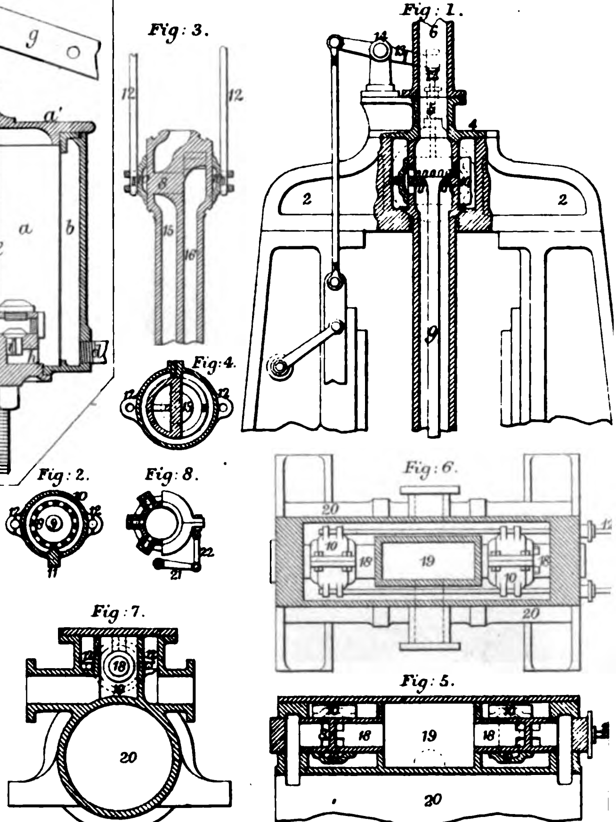


lubricating.

Fig: 3.



Stevenson's valves.



C Pilling, l

Payne's traction engine.

Fig: 1. Fig: 3.

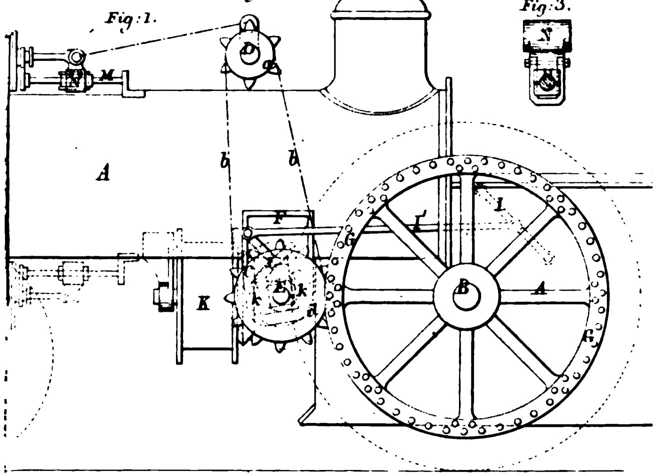
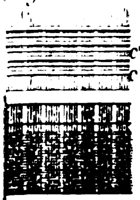
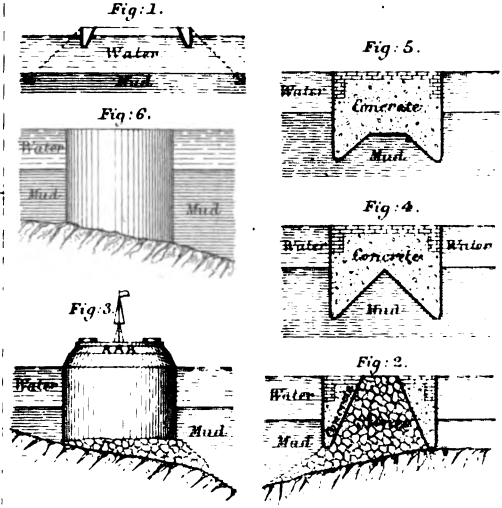


Fig: 1.

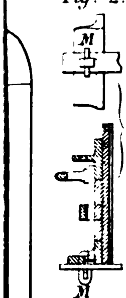


Heathorn's submarine structures.

Fig: 1. Fig: 5. Fig: 6. Fig: 4. Fig: 3. Fig: 2.

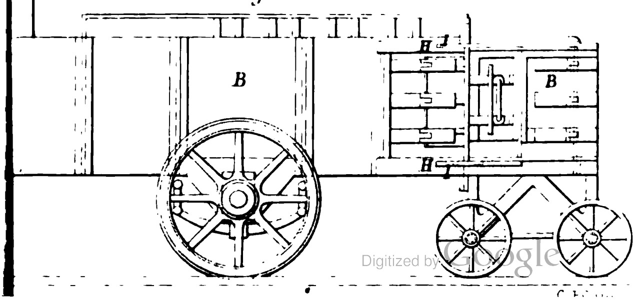


Figs 2.

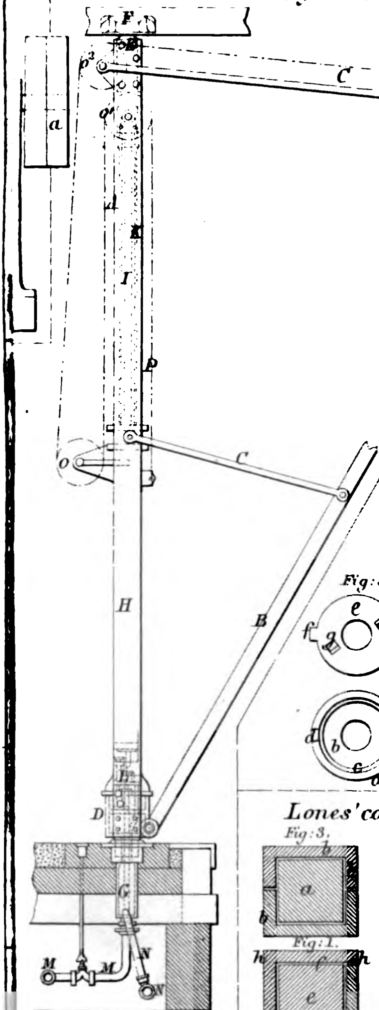


Thornton's cotton presses.

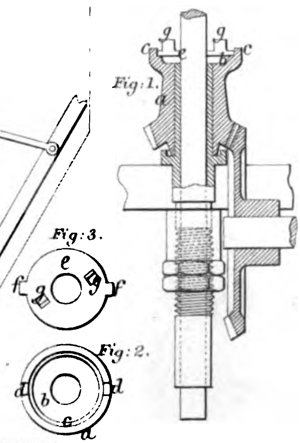
Fig: 1.



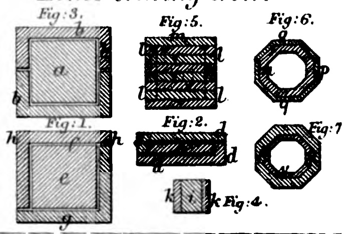
Westmacott's hydraulic crane.

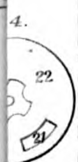


Calvert & Edmeston's spinning.

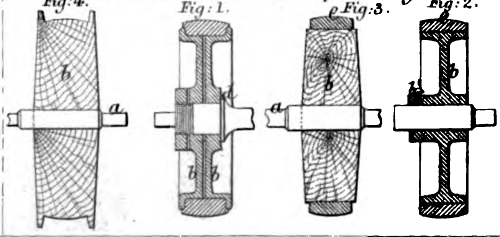


Lones' coating iron.

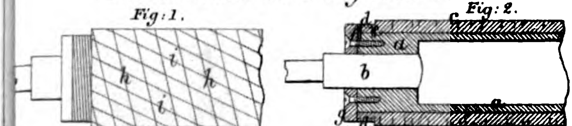




Barwick & Hartley's spinning.

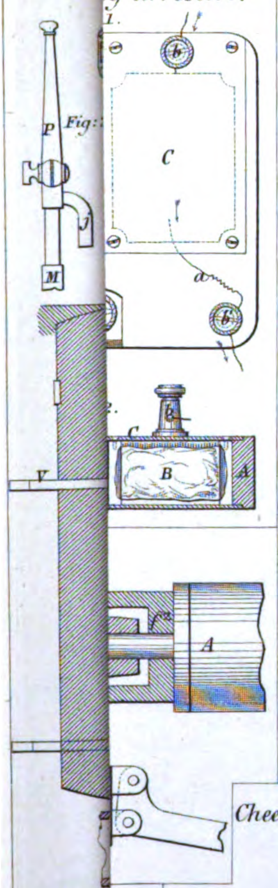


Richardson's covering rollers.

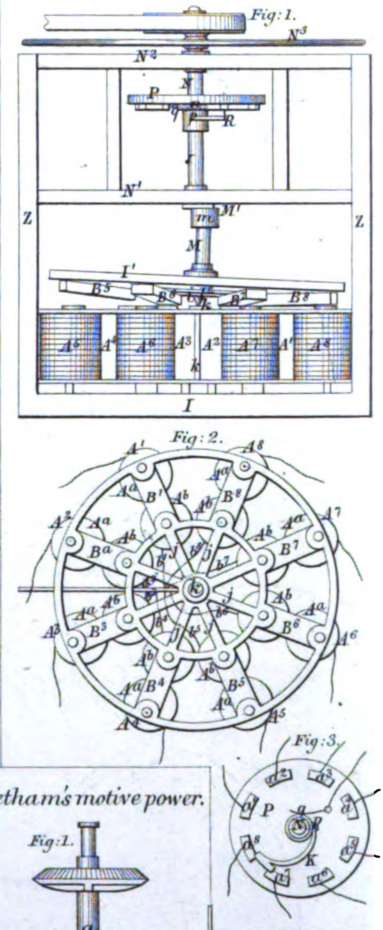


C. Pilling, lith.

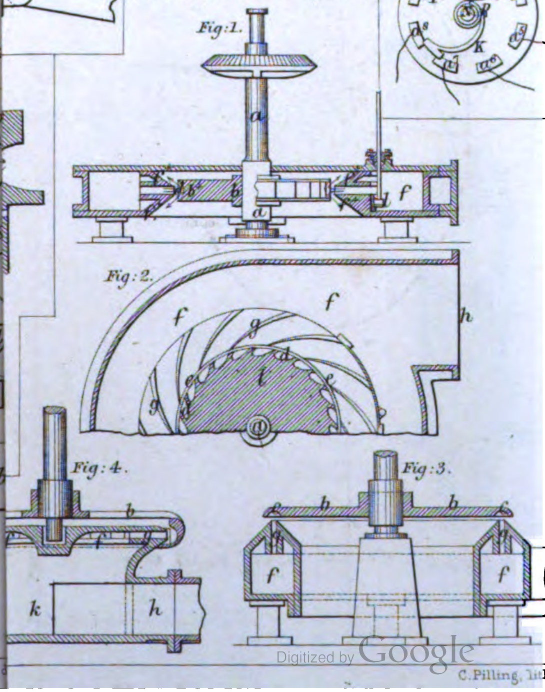
...g arresters.



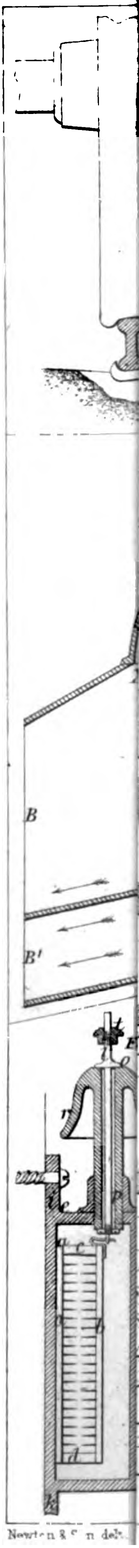
De Molin's electro-magnetic engine.



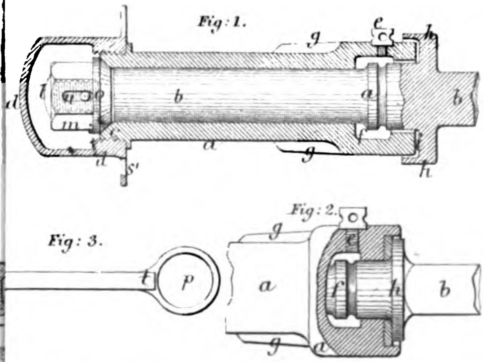
Cheetham's motive power.



Glo...

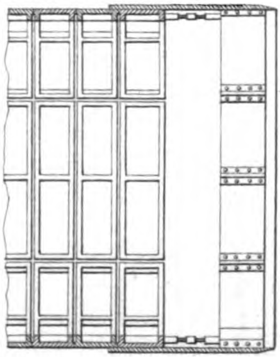


Richards' axles.

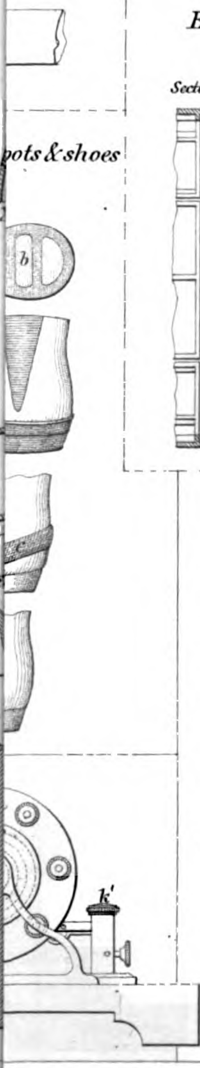


Barlow's tunnelling.

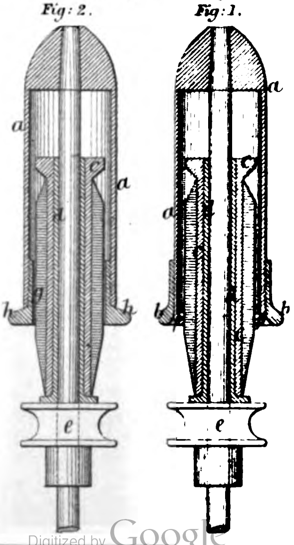
Section of tunnel.   Section of cylinder.



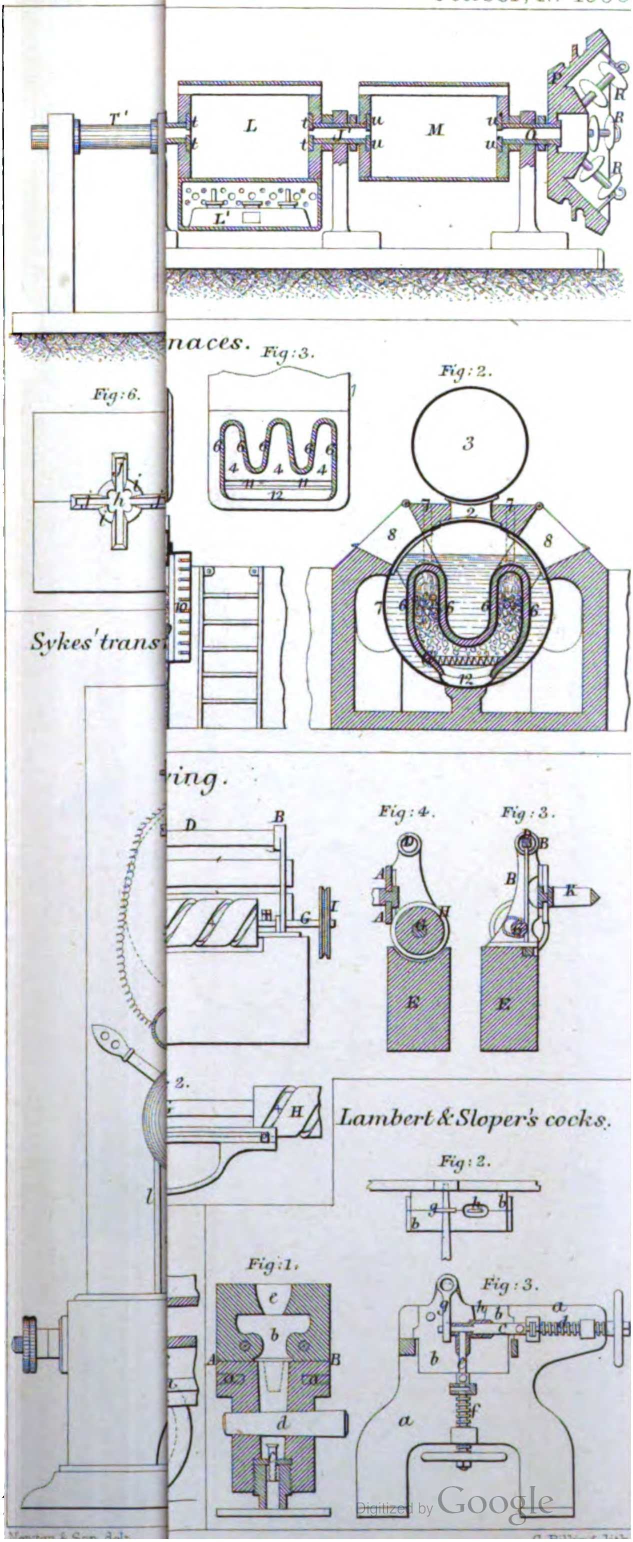
pots & shoes

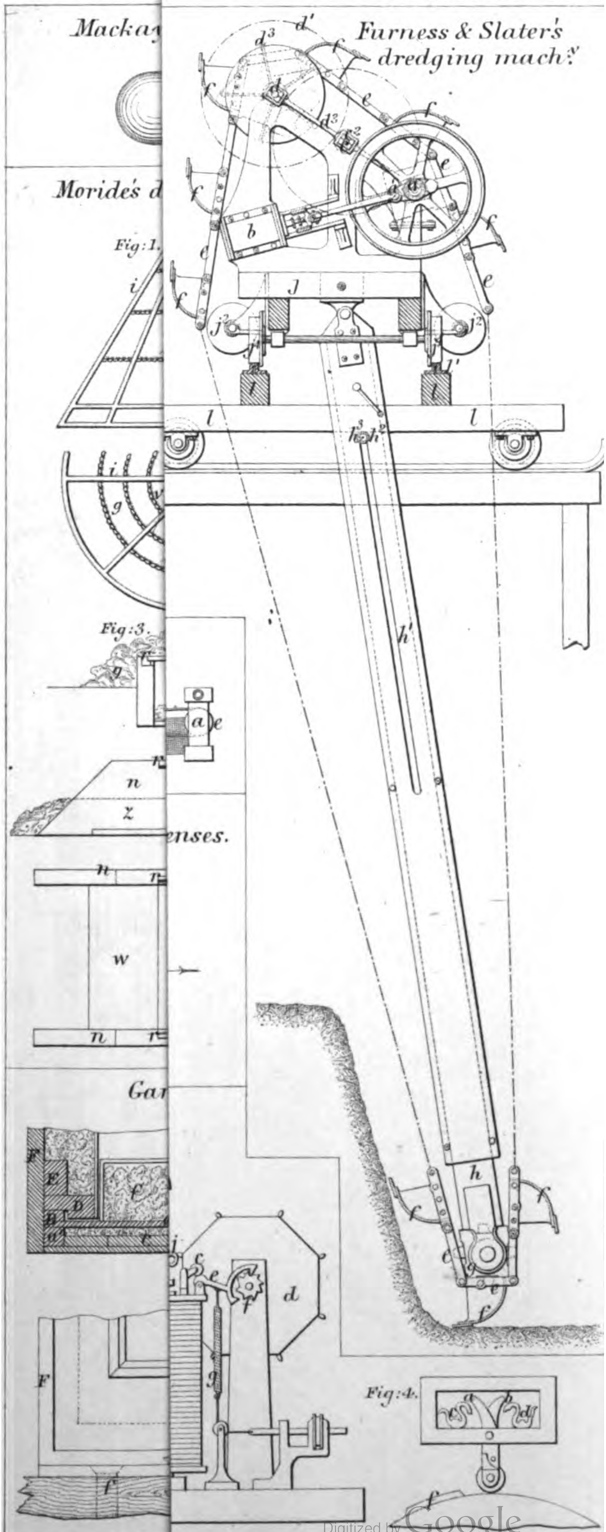


Smith's spinning.

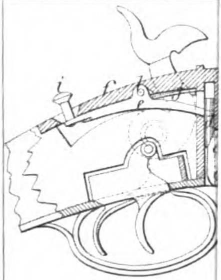


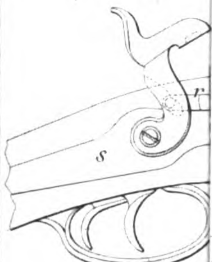
Newton & Son delt.   C. Pelton Sc.


naces.
Fig: 3.
Fig: 2.
Fig: 6.
Sykes' trans
ving.
Fig: 4.
Fig: 3.
Lambert & Sloper's cocks.
Fig: 2.
Fig: 1.
Fig: 3.



Newton & Son, delt. C. Pilling, lith





Bailly & oth.rs axles.

Fig: 1.

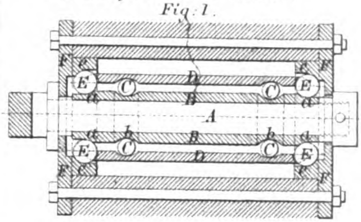
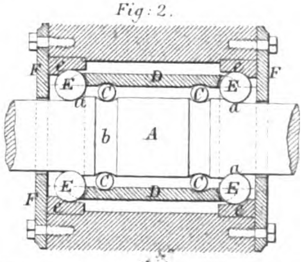
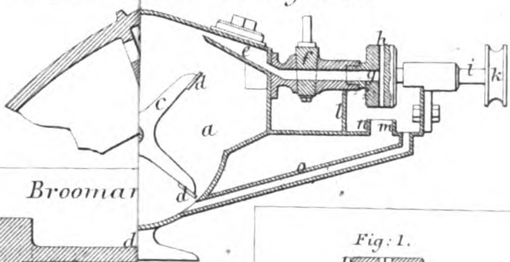


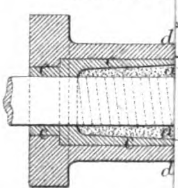
Fig: 2.



oberts' oiling wool.



Broomar



injector.

: 2.

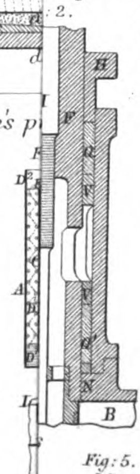
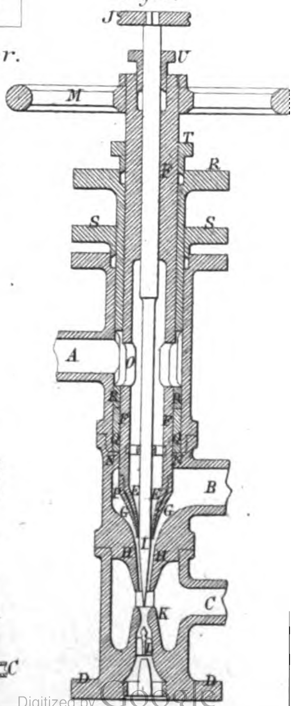


Fig: 1.



White's p

Fig: 4.

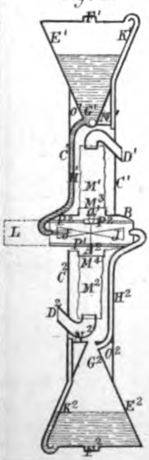
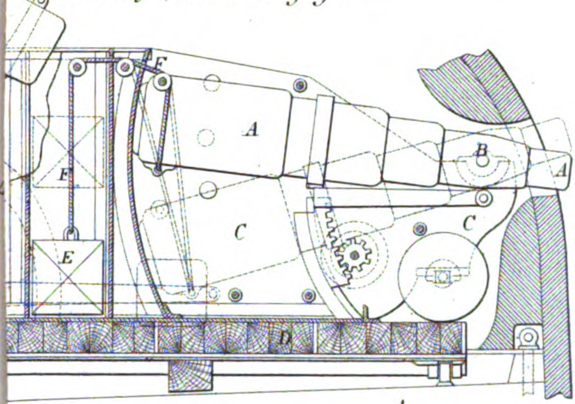


Fig: 5.

Blakely's mounting guns.



s drawing rollers.

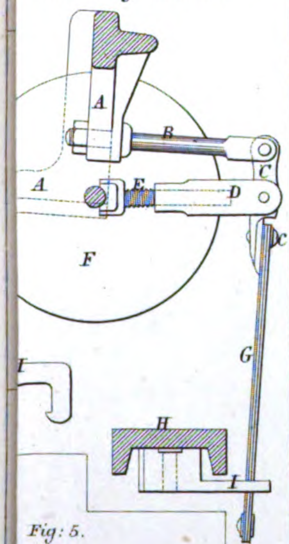


Fig: 5.

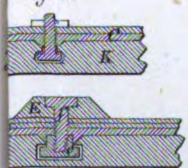
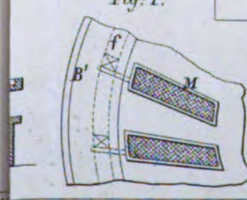
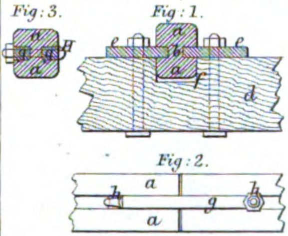


Fig: 1.



Jowett & Muschamp's railways.



Bell & Luthy's casting.

Fig: 2.

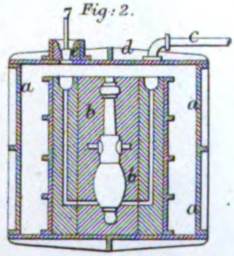
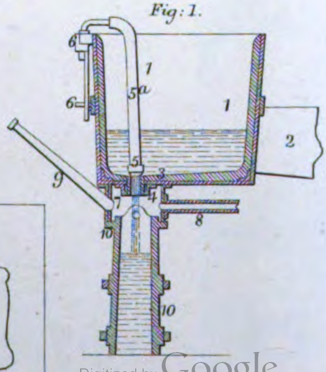
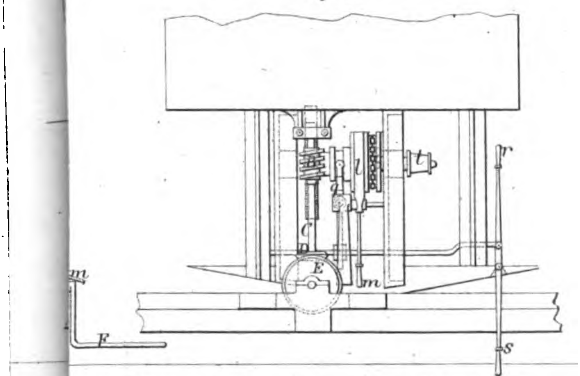


Fig: 1.



C. Pilling, lith.

Fig: 2.



Hall's gas burners &c.

g: 2.

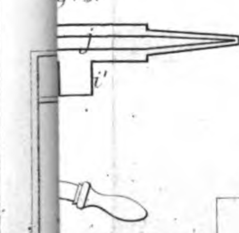
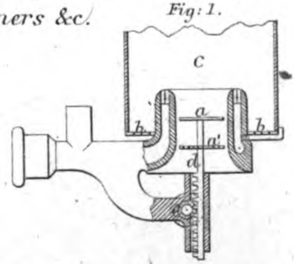
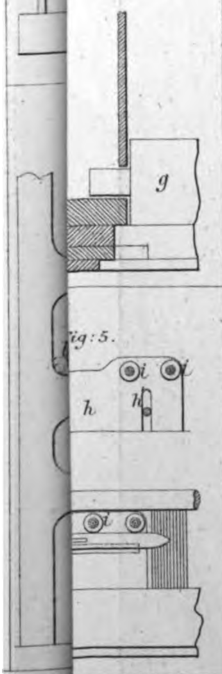


Fig: 1.



iron safes.



Taylor's mine cages.

Fig: 1.

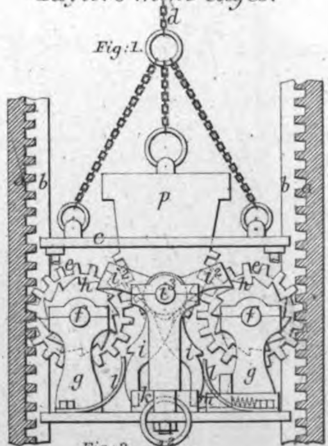
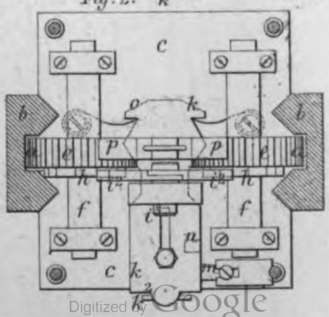
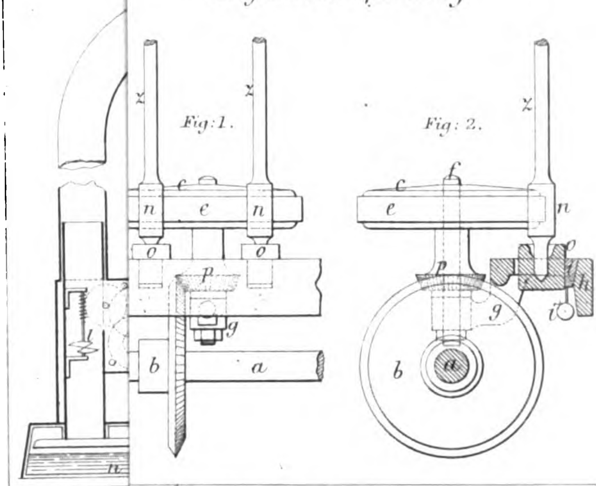


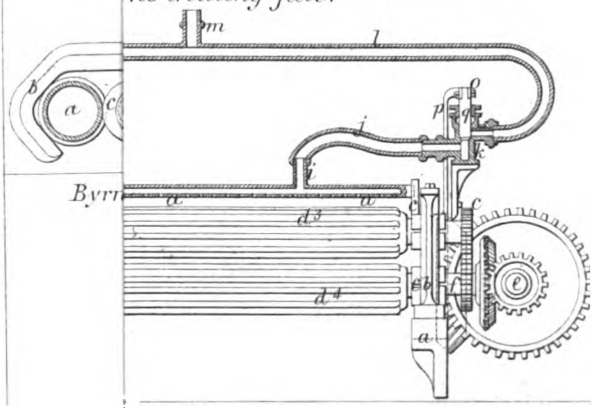
Fig: 2.



Llagostera's spinning.

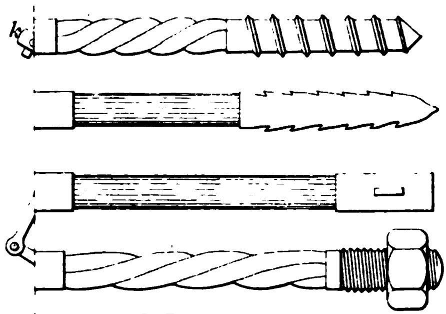


...n's treating jute.

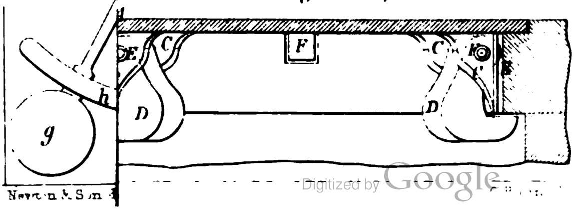


Byrn...

...unders' screws for armour plates.



Hood's securing coal plates.



Newton & Son